2020 (1) indian population
(2) indian food probleme
(3) " food production
(4) subsidiary foods
(5) indian food industries
(6) groundnuts
(7) food quality control
(8) food manufacture
(9) defence food

JW

DR S. S. BHATNAGAR, F.R.S.
Director, Scientific and Industrial Research
and
Secretary to the Ministry of Education and the Ministry of Natural Resources and
Scientific Research, Government of India

FOOD AND POPULATION

AND

DEVELOPMENT OF FOOD INDUSTRIES IN INDIA

CENTRAL FOOD TECHNOLOGICAL RESEARCH
INSTITUTE, MYSORE

First Published—1952

PRINTED IN INDIA
AT THE WESLEY PRESS AND PUBLISHING HOUSE
MYSORE CITY

INTRODUCTION

On various important occasions, Shri Jawaharlal Nehru, the Prime Minister of India, as well as Dr S. S. Bhatnagar, Director, Scientific and Industrial Research, have repeatedly stressed that one of the major objects of applied science is to be of benefit to the common man. So far as food is concerned, the problem before the country is, first, to ensure higher and cheaper production so that it may benefit all strata of society, and secondly, to make the industries "science-minded" so that, with the help of scientific knowledge, they will not only maintain but also improve steadily the quality of their Production.

In pursuance of this policy, the Central Food Technological Research Institute, Mysore, organized, in May 1951, two symposia on "Food and Population" and "Development of Food Industries in India". A large number of experts, industrialists, representatives of various food industries, Government departments, Universities and institutions participated in the Symposia. This book comprises all the papers read and discussed during the sessions of the Symposia, together with recommendations made by a Special Committee appointed on the suggestion of Shri T. Mariappa, Home Minister, Mysore, who presided over the Symposium on "Development of Food Industries in India".

The book consists of two parts. In the first part which deals with "Food and Population", two distinct schools of thought are evident. The demographers and economists draw attention to the fact that the population of India is steadily increasing at the rate of more than four millions a year and that agricultural production is hardly able to keep pace with it. This, it is maintained, will lead to increasing food shortage unless family planning is practised on a nation-wide scale. The agriculturists and administrators point out that the "Grow More Food Campaign" and other hydro-electric-*cum*-irrigation projects sponsored by the Government are already yielding results and will yield better results in the near future. This, according to them, will help to achieve self-sufficiency in food. However, in order to tide over the present food shortage, there is general agreement that immediate steps should be taken on the basis of the work

carried out at the Central Food Technological Research Institu and that food supplements of different kinds as well as subsidia foods from tubers like tapioca should be widely popularized b suitable means.

In the second part, on the "Development of Food Industrie in India", it is emphasized that agricultural and horticultur authorities should co-operate in making available to the Foo Industry the necessary raw materials of the right quality. Stres is also laid on the need for demonstrating proper processin techniques and giving facilities to certain industries for expand ing their market beyond Indian frontiers. Further, it is em phasized that the Central Food Technological Research Institut should continue to render all possible technical assistance t food industries.

Our grateful thanks are due to the Council of Scientific an Industrial Research, and particularly to Dr S. S. Bhatnagar, fo encouraging us in our efforts to hold the two Symposia in thi Institute and sanctioning the publication of the proceedings Grateful thanks are also due to all those who contributed s much to the organization of the Symposia and to authors wh presented papers and others who participated in the discussions.

Thanks must also be expressed to members of the staff of th Institute who co-operated enthusiastically, and especially to D G. T. Kale, Head of the Division of Food Information an Statistics, who was primarily responsible for editing and bringin out this volume.

It is felt that the views of experts and leaders of industr recorded in this book may ease the task of those who hav to bring about a co-ordinated growth of food industries in ou country.

V. Subrahmanyan
Director

Central Food Technological Research Institute,
Mysore

CONTENTS

PART I

PART II

ILLUSTRATIONS

ERRATA

Page 60, fifth line from below, read 'of it' instead of 'it off'

Page 95, line 8 from below, read 'Assistance' instead of 'Assistances'

Page 137, line 21 from below, read 'suggestions' instead of 'suggestion'

Pages 160, 161 and 162, line 10, 10 (from above) and 5 (from below) respectively, read 'confectionery' instead of 'confectionary'

Page 207, line 14, read 'some time' instead of 'sometime'

Page 149, line 10, read 'waiting' instead of 'awaiting'

Page 181, line 4, read 'proviso' instead of 'provison'

Page 182, last line, read 'sprang' instead of 'sprung'

Page 249, line 8 from below, read 'contribute' instead of 'contributes'

LIST OF PARTICIPANTS

Government of India

Ministry of Commerce and Industry

SRI V. A. MEHTA, M.Sc., Asst. Dev. Officer, Food Industries Development Wing, New Delhi.

Ministry of Defence

DR N. V. V. PARTHASARATHY, M.Sc., Ph.D., Defence Science Organization, New Delhi.

Ministry of Food and Agriculture

SIR DATAR SINGH Kt., Addl. Secretary (Agriculture), New Delhi.

DR B. VISWA NATH, D.Sc., F.R.I.C., Regional Agricultural Production Commissioner, Delhi.

SRI B. BANERJEE, M.Sc., Asst. Technical Adviser (Food), New Delhi.

Ministry of Health

DR K. MITRA, M.B.E., M.B., D.P.H., D.T.M. & H. (Lond.), F.N.I., Asst. Director General of Health Services, New Delhi.

Government of Madras

SRI J. L. P. ROCHE-VICTORIA, Minister for Food and Fisheries, Madras.

SRI J. M. LOBO PRABHU, I.C.S., Secretary, Development Dept., Madras.

SRI R. M. SUNDARAM, I.C.S., Secretary, Food & Agriculture Dept., Madras.

Government of Mysore

SRI T. MARIAPPA, B.A., LL.B., Home Minister, Bangalore.

SRI M. K. APPAJAPPA, B.A., Director of Agriculture, Bangalore.

SRI P. R. BALAKRISHNAN, B.A., M.A.I.Ch.E., M.I.E., Vice-Chairman, Mysore Iron & Steel Works and Director,

Metallurgical and Chemical Industries, Bhadravati.

SRI A. VIJAYA RAGHAVA REDDY, B.Sc. (Hons.), F.Z.S., M.C.S. Rationing Officer, Mysore.

Government of Travancore & Cochin

SRI V. K. R. MENON, B.A. (Hons.), M.A. (Lond.), Commissioner for Civil Supplies, Trivandrum.

Universities and Institutions

University of Allahabad

DR SRI RANJAN, M.Sc. (Cantab.), D.Sc., F.A.Sc., F.N.I., Head of the Dept. of Botany, Allahabad.

University of Annamalai

PROF. S. CHANDRASEKHAR, M.A., M.LITT., Ph.D., Director, Indian Institute of Population Studies, Chidambaram.

University of Bombay

DR A. SREENIVASAN, M.A., D.Sc., F.R.I.C., F.N.I., Dept. of Chemical Technology, Matunga, Bombay.

University of Mysore

DR S. V. GOVINDA SETTY, M.B., B.S., Professor, Clinical Medicine, Medical College, Mysore.

DR B. N. LINGARAJU, M.B., B.S., Prof. of Hygiene, Medical College, Mysore.

PROF. F. J. NORONHA, M.A. (Lond.), Dept. of Mathematical Economics and Statistics, Maharaja's College, Mysore.

University of Travancore

SRI N. SUBRAMANYA VARIER, M.Sc., Senior Chemist, Fishery Technology Dvn., Central Research Station, Trivandrum.

Indian Institute of Science, Bangalore

PROF. M. S. THACKER, Director, Indian Institute of Science.

DR K. V. GIRI, D.Sc., F.R.I.C., F.A.Sc., Prof. of Biochemistry.

DR S. S. DE, D.Sc., Food Technology Laboratories.

DR S. RAJAGOPALAN, B.Sc., Ph.D., A.I.I.Sc., Food Technology Laboratories.

Indian Red Cross Society, Bangalore

SRIMATI LAKSHMY P. KRISHNAPPA, B.A., B.T., Secretary.

Servants of India Society, Bangalore

MR & MRS P. KODANDA RAO

The Agri-Horticultural Society, Madras

SIR S. V. RAMAMURTHY, I.C.S. (Retired).

Food Industries' Associations

All India Food Preservers' Association, Bombay

SRI H. C. BHATNAGAR, M.Sc., Messrs Pure Products and Madhu Canning Ltd., Bombay.

SRI PRABHU DAYAL, M.Sc., (Tech.), Messrs Midland Fruit and Vegetable Products, Mathura.

SRI I. J. PURI, B.Sc., Messrs Kissan Products Ltd., Bangalore.

All India Vanaspati Manufacturers' Association, Bombay

MR G. FORD, Messrs Hindustan Vanaspati Co., Bombay.

MR A. K. SHOHET, " " " "

Confectionery Manufacturers' Association of India, Calcutta

MR N. A. PARKES, East India Distilleries & Sugar Ltd., Nellikuppam.

Deccan Oil-Seeds Crushers' Association, Sangli

SRI R. B. ARWADE, B.A., LL.B.

SRI G. M. SHAH, B.A., LL.B.

Federation of Biscuit Manufacturers' of India, Delhi

SRI N. R. SATHE, M.Sc., Messrs Sathe Biscuit & Chocolate Co., Ltd., Poona.

SRI NARENDRA DEWAN, Messrs Huns Dewan & Co., Ltd., Bombay.

SRI R. B. RAO, M.Sc., Messrs Britannia Biscuit Co., Ltd. Bombay.

Food Industries

Aerated Water Industry

SARDAR MOHAN SINGH, Director, Messrs Pure Drinks Ltd., Delhi.

Biscuit Industry

SRI BEDEKAR, M.Sc., Messrs Sathe Biscuit & Chocolate Co., Ltd., Poona.

Confectionery Industry

SRI G. H. VERMA, Prop., Hindustan Biscuit & Confectionery Works, Bombay.

Flour Milling Industry

SRI PREMNARAIN, M.Sc., Ganesh Flour Mills, Delhi.

Food Machinery

MR P. MARLOW, Messrs Baker Perkins (Exports) Ltd., Bombay.

Fruit & Vegetable Industry

SRI LUIS JOSE DE SOUZA, M.A., LL.B., Director, Messrs Food Preservers, Bombay.

SRI K. T. KALAYA, Fruit Technologist, Woshully Estates, Coorg.

Packaging Industry

MR G. COULTHARD, Messrs Metal Box Co. of India, Bombay.

Sugar Industry

SRI K. LAKKAPPA, B.Sc. (Hons.), Mysore Sugar Co., Ltd., Mandya.

Vitamin Industry

MR A. C. MUNRO, Messrs Hoffmann-La Roche & Co., Ltd., Basle.

Foreign Embassies

U.S.A.

MR S. R. CHARTRAND, Public Relations Officer, American Consulate, Madras.

United Nations—UNESCO

Dr C. Chandra Sekar, M.Sc., Ph.D., M.P.H., Director, United Nations Officer for Population Studies, Delhi.

Other Participants

Rajasevasakta A. K. Yegna Narayana Aiyer, M.A., N.D.D. (Eng.), Dip. Agr. (Cantab.), Rtd. Director of Agriculture, Bangalore.

Mr & Mrs R. Heath, Messrs Harry Ferguson of India Ltd., Bangalore.

Srimati P. C. Reddy, Maharani's College, Bangalore.

Sri T. Narasimha Iyengar, B.A., LL.B., President, Mysore City Municipality, Mysore.

Dr D. Sheshagiri Rao, M.B., B.S., D.P.H., Health Officer, Mysore City Municipality, Mysore.

Dr C. K. Sundarachar, D.Sc., Principal, First Grade College, Mysore.

Mr & Mrs Van Ingen, Mysore.

Sri N. K. Ranga Rao, M.Sc., General Manager, Lac & Paint Works Ltd., Mysore.

Dr C. V. Krishna Iyengar, D.Sc., Prof. of Botany, First Grade College, Mysore.

Sri Bundi Gowda, M.A., LL.B., General Manager, Mysore Sugar Co., Ltd., Mandya.

Srimati A. S. R. Chari, Women's Food Council, Bangalore.

Dr L. S. Doraiswamy, M.Sc., Ph.D. (Lond.), Economic Botanist, Dept. of Agriculture, Bangalore.

Sri Cheru, Managing Director, Canning Industries (Cochin), Ltd., Trichur.

Sri Ikkanda Warrier, Trivandrum.

Monsieur J. M. de Beaucorps, Representative, 'Alimentation Equilibrée', c/o French Associated Manufacturers, Bombay.

Mrs P. Marlow, c/o Mr P. Marlow, Messrs Baker Perkins (Exports) Ltd., Bombay.

Dr (Miss) A. G. Gillespie, M.B., B.S., Senior Medical Officer in-charge, Holdsworth Memorial Hospital, Mysore.

PART I

SYMPOSIUM ON 'FOOD AND POPULATION'

WELCOME SPEECH
BY DR V. SUBRAHMANYAN,

Director of
the Central Food Technological Research Institute, Mysore

We consider it a great privilege to welcome our honoured President, the Hon'ble Mr Roche-Victoria, and other distinguished friends who have so kindly responded to our invitation. All of you have important responsibilities and many of you have travelled over long distances to participate in the important discussions that we have before us. We are very highly thankful to you for your generous response.

Our Symposia have been objectively planned with a view to assessing critically our position and, arising from this, reaching important conclusions which we will submit to our Council and through them to our Government. The subject of 'Food and Population' that we have before us today is of vital importance to the country. It is going to be presented in its different aspects, by leading thinkers and workers, who have made a special study of the subject. With all of us approaching the subject in a detached and dispassionate manner, we should be able to reach useful decisions that will be of some value to the country.

Before resuming my seat, there are some rather important things which I should place before you. In the first place, the Hon'ble Shri Sri Prakasa has kindly sent us a message which I will read with the permission of the Chair. Secondly, Sardar Mohan Singh, one of our leading industrialists, who brought Coca-Cola to India, wishes to make an announcement which will no doubt interest you. Thirdly, during today's session, we will have two short breaks, one at eleven fifteen and the other at four in the afternoon when non-alcoholic liquid refreshments will be served. Fourthly, we would welcome you all to go round our laboratories and see what little we are doing. As you will be busy during most of today and tomorrow, we are arranging to receive you before the Symposia and between the forenoon and afternoon sessions. Fifthly, the Gymkhana of the

Institute wishes to have the pleasure of your company for a 'At Home' at 5.30 this afternoon. We are hoping that a of you have received our invitation, but in case, some of yo have not received it, we would request you to accept this a our invitation.

I will now read the Hon'ble Shri Sri Prakasa's message.

Message dated 16-5-1951 from the Hon'ble Shri Sri Prakasa Minister for Natural Resources and Scientific Research, New Delhi

(Read at the Central Food Technological Research Institute Mysore, on the 23rd May 1951, at 10.30 a.m. on the occasion of the opening of the two Symposia (1) Food and Population and (2) Development of Food Industries.)

1. It is a matter of very deep regret indeed to me that I am unable to be present at the Symposia organized by the Central Food Technological Research Institute for the 23rd and 24th May 1951. I had gratefully accepted the kind invitation of Dr Subrahmanyan to preside over the functions and was eagerly looking forward to coming and meeting so many colleagues and fellow-workers. I am, therefore, very greatly disappointed that at the last moment, urgent official and parliamentary work ha unexpectedly intervened requiring my presence in Delhi; and so I had regretfully to give up my programme of visiting Mysore I offer my apologies to all for any inconvenience I might have thus caused.

2. The subjects for the two Symposia are: (*i*) Food and Population, and (*ii*) Development of Food Industries. These ar matters of paramount importance to the country, especially a this critical juncture when we are faced with an acute shortag of food. I have every hope that those who will be participatin in the Symposium on 'Food and Population' will discuss th problem in all its manifold aspects, and will make useful an practical suggestions for its lasting solution.

3. I need hardly say that the path of wisdom lies not onl in finding ways and means of supplying more and more foo for the growing wants of an ever-expanding population, but als

in suggesting methods so that the population itself should be commensurate with the food available. Food values must also be carefully studied and propagated, so that avoidable disease and premature death could be eliminated. The subjects clearly are of absorbing interest; and my hope is that the scientists of eminence who will be tackling the problems involved, will succeed in their great mission.

4. The main aspects of the problem of food shortage are: (i) increase in the production of food-grains; (ii) improvement in crop yields; (iii) better methods of storage and preservation; and (iv) elimination of all wastage. There is also the question of utilization of certain classes of food materials which are fairly abundant but used only in certain regions and in times of emergency. It should be possible to popularize the use of such food materials throughout the country by practical demonstrations as regards their utility and nutritive values. Habits die hard, and this is particularly so in the case of food; but neither prejudice nor tradition should be allowed to stand in the way of changing people's food habits in the light of scientific investigation and emergent needs. The Central Food Technological Research Institute, I am sure, is paying every attention to all these aspects of the problem and assisting in the augmentation and conservation of the food resources of the country.

5. The development of industries for processing food products is equally important. I know there are difficulties such as the dearth of trained personnel possessing the necessary technical know-how; but I have no doubt that if determined efforts are made to harness the existing resources and facilities in the country, it is possible to make rapid stride in the development of this very important industry.

6. I have every confidence that all these matters will be discussed at the symposia and fruitful results will emerge out of such discussions. It is not for a layman to say more to experts and I shall close with my very best wishes for the success of the functions and the happiness of all who partake therein.

(*Signed*) Sri Prakasa
May 16, 1951

ADDRESS BY
THE HON'BLE MR J. L. P. ROCHE-VICTORIA,
Minister for Food and Fisheries, Government of Madras

FRIENDS,

I need hardly say how very timely today's symposium is Food is now our primary concern and a major pre-occupation This is not as it should be. But it is a legacy of the past, a part of the country's general economic backwardness and under-developed resources. In the south of India, at any rate, it is a long-dated problem. I have been told on reliable authority that it is with us for the past two centuries. Perhaps it is even longer. Recent events, in particular Nature's acts of unkindness such as cyclone, flood and drought have infinitely added to its complexity and intensity. I wonder whether parallel hunters could find any precedent in modern times for the failure of the monsoon in succession for the fourth year in vast regions of the peninsula.

The question thus has immediate and long-range bearings. No statesman can ignore one, except it be at the peril of the other and perhaps at his own and the community's. It is therefore refreshing to find that the Central Food Technological Research Institute has thought fit to arrange this symposium. It is a subject which affects the life and death of millions and therefore requires intense thought and attention of the best minds of the country. I am grateful to the organisers for the opportunity given to me to preside over the occasion.

The problem with which we are face to face is not peculiar to this country but is common to all the under-developed economies. The special feature of the problem is the pressure that a rapidly growing population exerts on a limited food supply. The reduction of population by the adoption of planned population policy, such as 'family planning' is also not feasible in view of the appalling poverty, ignorance, superstition and social customs that prevail in these countries. It will have to wait for spread of education and enlightenment and rise in living

standards. In the meantime, the solution lies in the evolution of sound economic policies.

Study of population trends reveals that population responds to economic changes. A predominantly agricultural economy like ours leads inevitably to surplus population on land, large-scale under-employment, low capital formation, indebtedness and other handicaps to progress. More and more land will have to be devoted to food production instead of to commercial crops which are likely to help capital accumulation. It may appear paradoxical, though true, that the more people there are on the land, the less is the total production and per capita production. The existence of cheap labour prevents adoption of labour-saving devices, both in agriculture and industry with the result that per capita productivity and income stand at a low level and industries, especially heavy industries, fail to expand. The presence of a large multitude, living on little above subsistence level, attracts only those industries which cater for the production of consumer goods. The only and sure way to get over these difficulties is rapid industrialization.

Industrialization both in the West and Japan provided an outlet for the surplus people on the land. In the sixties of the last century, some 60 per cent of the U.S.A. and about 19 per cent of U.K. population were engaged in primary production. By 1930, the percentage had been reduced to some 23 and 7 respectively with increased total and per capita production. Similar decrease though not to the same extent is seen in a number of other countries like Canada, Australia, Denmark, Italy and Japan.

Industrialization resulted also in a diminution of birth-rate; but, before this took place, there was a spurt in the growth of population in the early stages due to its effect on the more rapid decline in the death-rate. To avoid this spurt and to ensure a successful transition, industrialization must be heavily planned and should be done as quickly as possible. The large-scale hydro-electric projects the States have planned will come in handy for the supply of cheap electricity to cottage industries.

Is there enough food supply to go round for the people of

the world? Can they expect better living standards than their forefathers? Or will the population become too great for the available resources with all the terrible consequences that may follow from such a situation? These are the questions demanding our earnest attention. That there is too little food now in the world as a whole is obvious. Only a third of the population get enough and the right kind of food for health and high energy. Half of the population live at low nutrition levels. History shows that people always starved. But science shows how that could be avoided in the future by exploitation of techniques which were not available in the past.

The obvious solution is for a rapid economic development of the countries in Asia. Without such development even the welfare of the more prosperous countries is likely to be threatened as it will not be possible for them to sell their surplus food products to under-developed countries. There is thus every possibility of the danger that side by side with food surplus in certain countries of the world, millions may starve for want of purchasing power. The problem bristles with difficulties.

Where does India stand and is it possible for us to get over our difficulties in any reasonable measure of time? According to the latest census, the population of the Indian Union is 361.8 millions which is an increase of 42 millions or 13.5 per cent over the 1941 figure. Our rate of annual increase of population is 1.35 per cent. Our net reproduction rate is no doubt on the high side. Our density of population also stands very high.

During the past fifty years, the population of India has increased from 235.5 millions to 361.82 millions or by 126.32 millions or over 50 per cent. The area of land under cultivation has not increased to the same extent in the same period. Food production in the last decade has increased only from 40.615 million tons to 41.932 million tons or by 1.317 million tons which works out to 3.2 per cent only against an increase of 13.5 per cent of population.

The problems of food and population present a challenge to everyone of us. Probably the first requisite in tackling them is emotional stability. In the words of Dr Kellog, 'We must not

become panicky with despair or over-elated with optimism; we must have a conscience that cannot be lulled to inaction or cynicism with that tragic old half-truth "people have always starved and always will".'

There are immense resources available to science but there should be adequate goodwill also in the world, between nations. Given these two, we can confidently look forward to a solution of our food problem in the near future and without them the world will come to a sorry state of affairs in this matter as in all others affecting man's happiness. An advance in the sphere of the spirit should go hand in hand with the advances in science.

I am confident this symposium held here will result in certain concrete solutions to this all-absorbing and all-vital problem of food and population.

I wish the Symposium every success.

POPULATION DYNAMICS AND FOOD RESOURC

by

C. Chandra Sekar

(Director, United Nations Office for Population Studies, New Del

The paper traces the population dynamics of the Indian Union during the last seven decades and finds an explanation for the fast rate of growth in the population during the last thirty years in a rapid reduction in death-rates with no corresponding change in birth-rates. The LAISSEZ-FAIRE *attitude towards family size which has been in vogue has resulted in the adoption of methods for family limitation only by the comparatively well-to-do people living in urban areas. The economic and social development of the country which has been indifferent to the interests of vast rural populations has delayed the penetration of modernizing influences amongst them. Constitution of present trends may result in a rate of population growth of 2 per cent per annum in the next decade or two, a rate which, if it persists, will lead to the doubling of India's population in 35 years.*

*The increase in food supply, which is likely to result by 1960 because of the hydro-electric-*CUM*-irrigation projects now being undertaken by the Government, may be just sufficient to cope with the requirements of the increase in population which will occur by that time. The portents are definitely against India becoming self-sufficient in her food supply. The solution to the population-food resources problem lies not merely in first attempts to increase food production but in concerted efforts to reduce the fertility of the population.*

The economic and social development of the country has to be reorientated if the fertility of the agricultural population is to be rapidly reduced. It is to be hoped that the joint population studies by the Government of India and the United Nations, which will be shortly begun in the Mysore State, will be able to give necessary guidance. Science will continue to elucidate the inter-relationships of economic, social and population changes but it is the duty of the State to utilize what knowledge is currently available for the welfare of the population.

INTRODUCTION

Two extreme demographic situations stand out in the world today. In one, the population is predominantly agricultural and leads a precarious existence on less than an acre of cultivated land per capita. The average person spends the bulk of his income on food and yet his dietary is poor, averaging less than 2,000 calories per day, and lacks in proteins, fats and essential protective elements.[1] The striking feature of this demographic situation is that the death-rate of the population is high and so is its birth-rate. In years of prosperity mortality is reduced somewhat and population grows fast. With adverse conditions, famines and epidemics set in, death-rate increases and population growth is checked. Such a situation is characteristic of most of the Asian countries, including India. The other demographic situation is marked by a low death-rate as well as a low birth-rate. Population growth is slow and steady and, in the long run, is usually of a rate much less than that which results in the other demographic situation described above. The dietary of the average person is well balanced besides reaching a level of 3,000 calories per day. The higher level of living is seen associated either with an increase of non-agricultural pursuits or, if agriculture is still the mainstay of the population, with the availability of vast amount of land per agricultural worker.[2] The populations of Western Europe, United States of America, Canada, Australia and New Zealand can be said to conform to this type. Hardly one fourth of the world's population has reached such a high level of living. These two demographic situations are so striking that it is natural to ask if the high death-rate and poor economic conditions, as shown by most of the Asian countries, are not due to the high density of population and the availability

[1] *United Nations Department of Economic Affairs.* Economic Survey of Asia and the Far East, 1949, pp. 7-9, Lake Success, New York, 1950.

[2] The arable land per agriculture worker approximates 70 acres in Canada, 46 acres in the U.S.A. and 2.3 acres in the Indian Union.

of low acreage of land per capita. More often the question raised as to whether the Asian peoples are not going to further impoverished when their populations increase still furth in size. Various views have been expressed on these importa questions. At one extreme are those who put their faith ir plicitly on Malthus and feel that in such areas population w constantly press against the means of subsistence and the leve of living will continue to be low. There are others who a more optimistic and expect that as long as human ingenuity las a way will be found by which the level of living of the populations can be considerably improved. It is to be hoped th this symposium on Food and Population will help to clarify th many issues involved and present the problems in the righ perspective.

In the time at my disposal I propose discussing certain aspec of the mortality and fertility trends which have been observe in the past in the countries which are now in the two types o demographic situations referred to above and bringing out thei significance in a consideration of future population dynamic of the Indian Union and its food resources. Others that follov me may take up such questions as the relationship of populatio growth to standards of living and the portents which the presen demographic setting in India has on the future welfare an happiness of the vast population of this sub-continent.

Mortality trends in Europe and their effect on Populatio Growth:

Man, since the ages, has striven to gain mastery over natur and to improve his conditions of living. The extent of hi success is, in one sense, well demonstrated by the increase i expectation of life at birth, which has been attained by th populations in some of the European countries. A number o them (as well as others peopled predominantly by those o European origin) have recently recorded expectations of life o over 60 years. In many of these countries conditions of living over a century or two ago, were not much different from thos which exist in many Asian countries today. Want and poverty

ignorance and apathy, chronic malnutrition, occasional famines, infectious diseases and periodic epidemic outbreaks were the order of the day.[1] Whatever evidence is available, goes to show that in the beginning of the nineteenth century, the expectation of life of the European population was 35–40 years[2] not very much more than the figure quoted for the present day Indian population.

Various factors have contributed to this phenomenal change in the mortality conditions in Europe during the last hundred years or so. Famines were overcome and food shortages were gradually eliminated by improved methods of agriculture, new means of transportation and storage and increased importation of food from overseas. Greater emphasis on personal hygiene and the introduction of elementary sanitation measures led to the reduction of deaths from epidemic diseases, in some cases even long before their aetiology became known. Progress in medicine, of which a real beginning was made towards the middle of the last century, resulted in a better understanding of disease causation and its control. The growth of medical profession and increased provision for curative care, the development of large-scale public health programmes, the growth of humanitarianism which manifested itself in social work, hospitals, clinics and social welfare activities of many kinds, and the emergence of a liberal social attitude which led to the improvement of conditions of labour, have all played their part in the revolutionary change which has been made in the mortality conditions.[3]

Analysis of the trends in the expectation of life in these countries during the last 100 years shows clearly that progress in

[1] For more detailed description, see Stern, B. J., *Society and Medical Progress*, Princeton, 1941.

[2] See Dublin, L. I., Lotka, A. J. and M. Spiegelman, *Length of Life*, p. 35, New York, 1949.

[3] For a discussion of the factors which contributed to the decline in mortality in the West, see *United Nations* Document E/CN. 9/73—Findings of Studies on relationships between population trends and economic and social factors. Chapter I—Economic and Social factors affecting mortality, pp. 18–24.

the reduction of death-rates was much slower till the end of the last century as compared with the changes which have been effected subsequently.[1] The main explanation for this difference is that whereas the initial reduction in the death-rates was due primarily to such factors as an increase in food supply and the control of a few epidemic diseases, in the latter stage rapid advancement in medical science provided cheap and efficient methods to improve public health and to control mortality from a number of diseases. This feature has an obvious significance in a consideration of the rate at which mortality can be reduced in areas where it is now at a high level.

The effect which the reduction in death-rates had on the rate of natural increase of the population in the European countries is also not without interest for the present discussion. This rate is given by the excess of birth-rate over death-rate. As such, its trend was governed by what happened to fertility when mortality got reduced. Among the European populations (barring France, which had shown a decline in fertility even during the seventeenth century) the reduction in fertility did not come about till 40 or 50 years after death-rates had begun to decline. The gap between birth- and death-rates, therefore, continuously widened in Europe till about the third quarter of the nineteenth century. Once, however, the decline in fertility started, it persisted almost continuously till the outbreak of the last World War.

The lag between the reduction of fertility and mortality was not the same in different sections of each country's population. Whereas mortality reduction permeated readily into the various strata of society, fertility reduction, when it first manifested itself, was essentially a feature of urban areas. The spread of the limitation of size of family into rural areas and into lower economic groups was slow and, even today, agricultural populations have a much higher fertility than urban populations.

[1] For trends in expectation of life see—

Hart, H. and Hertz, H.—Expectation of Life as an index of social progress. American Sociological Review (Manasha—Wisc.), Vol. 9, December 1944, pp. 609–621.

Two features in regard to population growth stand out clearly from the demographic transition described above. One is that for long after the reduction in mortality was first observed, the population grew at an accelerated rate, this acceleration being shared more or less equally by all sections of the population. The second feature is that even when fertility had begun to decline, certain sections of the population were slow to change with the result that populations in these sections continued to grow at a rapid rate for a still longer period.

POPULATION DYNAMICS IN THE INDIAN UNION:

The rates of India's population growth during the eight decades after 1872, when the first Census was taken, show two remarkable patterns.[1] In the earlier phase, the rates fluctuated widely and a period of low increase was followed by one much higher and *vice versa*. Thus, of the five decades prior to 1921, in three, namely, 1872-81, 1891-1901 and 1911-21, low rates of increase were recorded. These have been attributed to the recurrence of famines and epidemics. In the other two intervening decades, food and health conditions were more satisfactory and comparatively higher rates of increase were registered. Since 1921, however, the pattern changed and the rate of population growth has been consistently high. The decade 1921-31 recorded

[1] PER CENT INTER-CENSAL INCREASE IN THE INDIAN UNION

Year	*Population in millions*	*Per cent inter-censal increase*
1951	356·9*	+13·4
1941	314·8	+14·3
1931	275·5	+11·0
1921	248·2	— 0.3
1911	249·1	+ 5·8
1901	235·5	+ 0·9†
1891		+ 9·5†
1881		+ 1·4†
1872		

* Provisional figures.

† These increases apply to India before separation of Pakistan.

an increase in population of 1 per cent per annum. Durin 1931–41 and 1941–51, the rates of growth increased still furthe and reached the levels of 1.4 and 1.3 per cent respectively.

The increase in the rate of population growth in the recen decades, particularly after an era of widespread famines an epidemics, shows a striking similarity to what happened i Europe with the growth of industrial development when mortalit started declining. If the causal mechanism implied by thi comparison is at all valid, it would mean that there has bee an improvement in the conditions of living of India's people Be it as it may, the problems that lie ahead can only be under stood in the light of the mortality and fertility trends whicl have occurred in the past in India and a consideration of wha is likely to happen in the future.

The estimated death-rates for the different decades show a conspicuous fall in mortality after 1921. Whereas the death rate averaged 44 per thousand prior to 1921, the rate since tha date has stood in the neighbourhood of 32 per thousand.[1] Thi decline in mortality is not surprising when seen against th economic and social development in the country and particularly the attempts that have been made to control famines and to improve public health.

In regard to birth rates, however, no significant decline ha as yet occurred. The only State measure introduced in th last few decades, which may have had a bearing on fertility wa passing of the Sarda Act which raised the minimum age o

[1] Kingsley, Davis—*Demographic Fact and Policy in India in Demographic Studies of Selected Areas of Rapid Growth.* Millbank Memorial Fund, 1944, p. 41.

ESTIMATED BIRTH- AND DEATH-RATES AND RATE OF NATURAL INCREASE

Decade	*Birth-rate*	*Death-rate*	*Natural increase rate*
1881–1891	49	41	8
1891–1901	46	44	2
1901–1911	49	43	6
1911–1921	48	47	1
1921–1931	46	36	10
1931–1941	45	31	14

marriage. Although, as a result of it, marriages have been delayed somewhat,[1] no appreciable effect on fertility has been produced. The *laissez faire* attitude towards family size, which is in vogue, has resulted in the adoption of methods for family limitation only by the comparatively more well-to-do people living in urban areas. The large bulk of India's population living in rural areas still follows the social and ethical codes of the previous generations and continues to have a high fertility.[2]

What is the future rate of India's population growth likely to be? The mortality and fertility trends in the country have shown clearly that a demographic transition similar to the one which occurred in Europe during the last century has set in. Mortality has started declining, with no significant change in fertility. The lag in the fall of mortality and fertility did accelerate the rate of population growth in Europe. Should such a lag occur in India, the normal expectation is that its population will grow at a rate very much faster than what was observed in Europe. Two factors warrant this conclusion. The first refers to the speed with which mortality rates can be expected to go down. Progress in medical science since the turn of the century and particularly after the second World War has provided new means by which drastic reductions in mortality can be made within a very short time. The use of DDT in

[1] In a survey conducted by the All-India Institute of Hygiene and Public Health, in 1947-48, in Calcutta, it was found that for rural Bengali women the average age at marriage had progressively increased from 10.3 years for women married 20 years or more before the survey was made to 13.7 years for women married within 5 years preceding the survey. In the case of women of 'moderate' economic status in Calcutta the age at marriage during the same period increased from 11.5 to 16.8 years. For women of 'higher' economic status, surveyed in Calcutta, the age had increased from 13.3 to 19.3 years.

[2] In the survey by the All-India Institute of Hygiene and Public Health referred to in (1), it was found that rural married women (excluding widows) over 40 years of age had an average of 7.5 live births, the number diminishing to 6.3 and 5.6 respectively for women of 'moderate' and 'higher' economic status in Calcutta.

the control of malaria has produced a phenomenal decline in mortality in Ceylon, where death-rate dropped from 20 per thousand to 13 per thousand in the course of two years. In India where malaria is the chief killer and a start has already been made in the use of DDT, a speedier reduction in mortality as compared with that of the nineteenth century Europe is particularly to be expected. Another reason for expecting a faster rate of population growth in India is that its present level of fertility is far higher than that which prevailed in the nineteenth century Europe and, therefore, the reduction of mortality to European levels will result in a much larger difference between birth- and death-rates. The potentialities of population growth can be seen from the following simple calculation. If, for instance, the Indian birth-rate continues to stand at its present level of 42 per thousand and the death-rate is reduced to, say, 22 per thousand from its present level of 30 per thousand, India's population will increase annually at the rate of 2 per cent.[1] This will imply the doubling of population in about 35 years.

The rate of population growth of 2 per cent per year obtained in the above calculation should not be considered as a remote possibility but what one may reasonably expect in the next decade or two, if India neglects, as in the past, the economic and social development of rural areas and thereby delays the penetration of modernizing influences into the vast agricultural sections of her population.

Population Growth and Food Resources:

The lack of adequate statistics prevents a direct comparison between the increases in population during the last few decades and the increases in food resources.[2] The land under cultivation per capita has, however, shown a progressive diminution[3] (and

[1] The levels of birth- and death-rates assumed to be now current are only rough estimates.

[2] It is generally agreed that production figures prior to 1940 can hardly be relied on.

[3] The area of land sown per capita diminished from 0.88 acres in 1911-12 to 0.71 acres in 1950.

the trend has been particularly aggravated by the separation of Pakistan) and one might reasonably suspect that the available food per capita purely from local sources has also diminished. This suspicion gains greater strength when seen against the difficulties which have been recently experienced in providing food for the present population even after obtaining enormous food supplies from overseas.[1] The view that food supply has not caught up with the increase in population may seem somewhat at variance with our earlier observation that in the last few decades the death rates have been declining. As is well known, health of an individual is determined both by food supply and risk of disease from external environment. It may be that an improvement in the latter may lead to an overall improvement in the health of the nation as long as the food supply does not fall below a critical minimum.

What form is the population-food resources problem likely to take in the near future? The factors affecting the rate of population increase have already been discussed and it has been shown that a rate of growth as high as 2 per cent per annum can be expected in the near future. Already India's population is increasing at the rate of 4 million per year, and if the anticipated rate of increase is realized, the population will grow by over 6 million per year. At the present time the chief hope for augmenting local food supplies lies in the programme of the Government to construct a series of hydro-electric-cum-irrigation projects. Eight multi-purpose schemes, one major irrigation scheme and a large number of minor schemes are under actual

[1] The quantity of food imported into the territory now comprising Indian Union has progressively increased since 1944. Comparative figures are as follows:

Years	*Imports* (1,000 tons)	
1944–45	1839	From *Eastern*
1945–46	2494	*Economist* Annual
1946–47	2728	Number, 1949,
1947–48	3250	page 1052.
1948–49	4000	

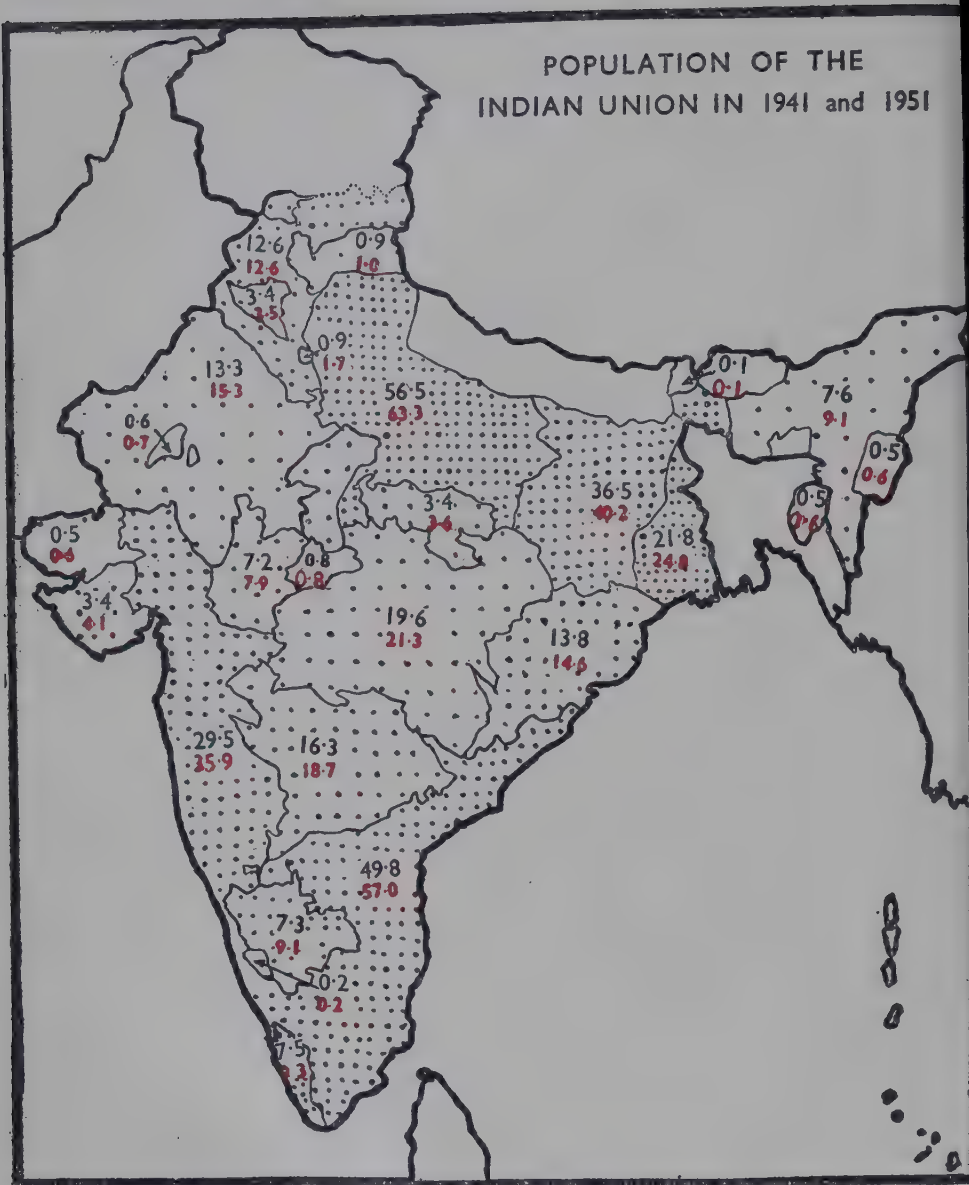
construction.[1] These schemes are being undertaken at huge cost (the estimated cost for the eight multi-purpose schemes and th major irrigation scheme is Rs 430 crores) and it is accepted o all sides that during the next decade, these would form th major government undertakings for augmenting food supplie in the country. As a result of these projects, it is anticipate that food production will increase by 4 million tons or roughl by 10 per cent by the year 1960. But, by 1960, the populatio will also increase by another 50 millions or by 13 per cent. It i evident that the expected increase in local food supply durin the next decade will hardly be sufficient to do more than jus meet the needs of the increase in population during that period Unless, therefore, the rate of population growth is checked, ou dependence on the importation of food grains from abroad i not likely to diminish at all in the foreseeable future. This i indeed a grim prospect. The real solution of the population food resources problem of India would, therefore, seem to li not only in added effort to increase the food supplies withi the country but also to bring about a simultaneous reduction i the fertility of the population.

It has already been pointed out that India's vast agricultura population has yet shown no tendency to reduce its fertility an that for years to come it will present the major demographic pro blems. The type of economic or social development which brings only the urban population into direct contact with th salutary influences of modernization will have to face the problem of excessive growth in agricultural sections of the community fo long after the process of industrialization sets in. If, however the development of the country could be so directed that it wil also result in revolutionizing the attitude of rural population an accelerate the spread of voluntary family limitation among them the population and economic problems could be attacked simultaneously.

The effects of various types of economic and social development on population growth are far from being clearly understood

[1] New projects for irrigation and power in India, 1950. Central Board of Irrigation Leaflet, No. 3, p. 26.

id it is for this reason that the United Nations Population ommission have given top priority to a study of the subject. is encouraging to note that the Government of India has tended its co-operation to the United Nations for undertaking ecial studies in this field. It may also be of interest to note at the very State where this symposium is held has been ntatively selected as the venue for the first investigations. ience will continue to elucidate the inter-relationships of onomic, social and population factors, but it is the duty of e State to utilize what scientific knowledge is currently available r the welfare of its population.



Figures in black indicate population (in million) in 1941.
Figures in red indicate population (in million) in 1951.
Dots indicate population density.

INDIA'S POPULATION PROBLEM

by

Dr S. Chandrasekhar,

(Director, Indian Institute for Population Studies, Baroda University, Baroda)

Today our population is 362 millions (361.82 millions). This represents an increase of about 13.5 per cent over the population in 1941 (318.86 millions) adjusted to the present area. Thus, the population of our country increased by some 43 millions in the last decade and by about 50 millions in the earlier decade of 1931–41.

Though the RATE *of growth compared to certain countries both in the West and the Far East is not very high, the net addition every decade is very impressive and is larger than the entire population of several prominent countries. But even this net addition of 40 or 50 millions every decade or a total population of 260 or 400 millions or even more need not constitute a problem* IF *an overwhelming majority of the people, not to speak of everyone, enjoyed the irreducible requirements of decent human existence in terms of food, clothing, shelter, educational and medical facilities, and some leisure to pursue cultural values. But the standard of living is very low in India. And apart from this necessary material aspect, the qualitative aspect of our population is very discouraging.*

What is the relation of the growth of our population to this miserable standard of living of our people? What is a Standard of Living? The concept is rather difficult to define, at least in terms of Asia or our own country. A standard of living is a level of comfort which some one hopes to have, or wishes he had, or thinks he ought to have. Despite the difficulty of a definition, we all know that the majority of the Indian population does not get enough food to eat (not to speak of the quality), enough clothes to wear, proper houses to live in, enough schools to send their children to, or enough hospitals and doctors to take care of the ailing. If we compare the

PER CAPITA *consumption of these goods and services with such countries as the United States of America, Canada, Argentina, Sweden and New Zealand, we don't enter the picture at all. Compared to even the backward Western countries and Japan we fare badly. Even if we devise standards to suit our very simple needs, our production at home and ability to buy abroad are so limited that the logic of reduced rations becomes inevitable. We need no elaborate statistical details to prove this.*

Our death-rate is very high. Our over-all death-rate of 30–35 mille (allowing for official under-registration) is one of the highest in the world. While the all-round death-rate is appalling enough, the death-rate by various age groups (e.g., infant mortality and maternal mortality) is incredibly shocking. All of us agree that we should try to lower this mortality to some civilized figure. Already there is an indication of a slight fall in our death-rate in the last twenty years. And once our efforts to improve public health, sanitation and medical services bear fruit, there will be a further fall in our death-rate. This would mean more mouths and bodies to take care of, when we are unable to meet even the elementary needs of the existing population. Of course every mouth brings with it a pair of hands BUT THE MOUTH BEGINS TO FUNCTION IMMEDIATELY; IT IS TEN OR FIFTEEN YEARS BEFORE THE HANDS ARE OF ANY USE. *Then there is the problem of unemployment.*

All this simply means that a planned and purposeful control of mortality without a corresponding control of the birth-rate can only have disastrous consequences for India. It is also clear that efforts to raise our poor standard of living and ever-increasing growth of population are simply incompatible.

India's population problem arises primarily out of an extremely high fertility accompanied by high mortality which is only slowly declining. The resulting increase, which amounted to

more than four millions a year in undivided India, apart from the very low survival value, need not constitute a problem if the Indian level of living were high enough to absorb the additional population without reducing the level of living. But India's level of living is so low that any further addition to the number of poor families may well be disastrous; and as they are so numerous it may be generalized that the total population as such will find further increase a great problem. India's density in agricultural as well as in the poorer strata of urban society, though not as great as in certain overcrowded parts of the world, is too great to permit an attitude of *laissez-faire;* it is difficult to see how more people could be taken care of. Nor is there any migration outlet for the Indian people. Even if some countries could welcome Indians as immigrants, they cannot possibly receive four million a year; nor is it reasonable to expect such a large number of 'stay-at-home' people to move out of India every year. The net addition of four or more millions a year, or fifty millions in a decade, or a grand total of 350/400 or even more millions in India, need not constitute a problem if an overwhelming majority of the population, not to speak of everyone, enjoyed the irreducible minimum requirements of decent human existence in terms of food, health, clothing, shelter, employment and leisure for recreation. But this is not so in India and, what is worse is the well-known and depressing qualitative aspect of the Indian population problem. And as the quality of the people is related to the quantity, it cannot be improved without controlling the quantity. Hence the danger, in the number of India's teeming millions to her over-all economic and social development and her place in the modern world.

Growth of Population

In the sixteenth century, according to some rough estimates, the population of the sub-continent was about one hundred millions. In the middle of the nineteenth century the figure reached about 150 millions. In 1881 when the first regular, although incomplete, census was taken, the population stood at 254 millions. In 1931, fifty years later, the census revealed 353

millions, representing an increase of 10.6 per cent over the 1921 figure. The last census of 1941 showed a total of 389 millions, showing an increase of 15 per cent over the 1931 figure or an increase of 50 millions. The 1951 census may show a similar increase, if the present trends of mortality and fertility continue.

The *rate* of increase of the Indian population, though high, has not been abnormal. For instance, between 1872 and 1941 the population of undivided India grew by 54 per cent. The United Kingdom during the same period increased by 56 per cent. Japan during the same period increased by 136 per cent. So the rate of increase has not been very rapid. But the growth over the years has not been uniform, for the controlling factor has not been increasing fertility but fluctuating mortality. The population has responded to the presence or absence of wars, famines and epidemics. As these checks appeared or disappeared, the population grew and declined accordingly. Voluntary limitation of births, has not played any significant role in determining the size of the Indian population. Till 1901 the population was almost stationary. The years between 1901 and 1921 witnessed an irregular and spasmodic growth of population. In the three decades between 1921 and 1951 the country registered a growth of 10.6 and 15 and 13.5 per cent respectively. And if the present public health conditions continue unaccompanied by any famine, the 1961 census may show yet a large addition.

But the problem in India is not the rate of increase but the *net addition* to the existing population every decade. Because of the large number of India's existing population, even a modest rate of increase of 10 or 15 per cent yields a net gain of some 50 millions (as during 1931–1951), in itself larger than the population of any European country except Germany or Russia, or any Latin American country. And it is this large net addition that constitutes the problem because it nullifies all efforts to improve the admittedly very low standard of living of the Indian people. All efforts to increase the production of food, other commodities and services to give a better *per capita* share to the existing population are largely frustrated by an increasing addition to the population. Thus, in the present circumstances,

improvements in the Indian standard of living and the increasing growth of population are incompatible.

Fertility

Among all demographic factors, the rate of fertility is the most important, for international lack of balance in fertility levels constitutes the crux of the world population problem. Within a nation fertility differentials between different ethnic, cultural, economic and religious groups constitute a serious problem in the formulation of any democratic population policy.

If Indian vital statistics are accepted as somewhat reliable, despite their well-known inadequacy due to under-registration, we find that the birth-rate is between 45 and 50. The figure for 1941 is 43 and this is comparable to high birth-rates in Egypt (47 in 1940), Palestine (40 in 1935), Puerto Rico (40 in 1942), and Mexico (42 in 1940). A discussion of the corrections to be made in the estimated and recorded rates of fertility cannot be entered into for lack of space, but the table below gives India's birth- and death-rates per mille since 1885. The significant fact about the Indian birth-rate is not that it is one of the highest in the world but that it has shown no signs of declining during the last fifty years. It is obvious from the table that there is no definite downward trend and the little variation that is seen must be taken to be a natural and normal fluctuation for such a high figure.

As for rural-urban fertility differentials, India conforms to the experiences of other countries. In Western and industrialized countries, the decline in fertility began in urban areas, and the rural areas tended to follow the downward trend after a time lag. This has been so because industrialization has been accompanied by the widespread adoption of the planned family habit. Though India may conform to this experience eventually, it has not been the case till now. The lower fertility in Indian urban areas must be explained in terms of adverse sex ratio in the cities, where the relative paucity of females and absence of wives constitute a remarkable feature. Indian industrial workers have a rural background and they come to the cities in search of

employment only when they are faced with agrarian distress Hence they come to the cities single, unaccompanied by thei wives and children. When agricultural conditions improve, large segment of these industrial workers return to their village and to agriculture. Another reason for this rural-urban fertilit differential may be the high infant mortality rate in the cities Thus the differential cannot as yet be explained in terms o either the availability or the adoption of contraceptive techniques.

An examination of the fertility rates by occupational an income groups reveals, however, a slight decline in the higl income groups. This group generally embraces the so-callec higher castes who have better educational qualifications, bette jobs and, consequently, a higher standard of living. Here again the lower fertility cannot be explained in terms of birth control Though adequate data on the question are lacking, the rea question behind this is the social ban on widow remarriage, which withdraws many women from potential motherhood. As thi ban on widow remarriage is not generally observed among the lower income groups (which roughly correspond to the so-callec low castes) the fertility of this group is high. Thus, the littl decline in fertility that is registered for certain groups of the Indian population has not become a marked trend and the differential is not large enough to affect adversely the futur growth of population. So, if there is no change, the only facto that will contribute to the reduction of the future growth o Indian population will be not the deliberate control of the birth-rate but high mortality. And this is something that cannot b looked upon with equanimity.

BIRTH- AND DEATH-RATES OF INDIA PER MILLE SINCE 1885.

YEAR		Birth-rate		Death-rate		Natural increase	
		Recorded	Estimated	Recorded	Estimated	Recorded	Estimated
1931–41	...	45	...	31	...	...	...
1931–35	...	35	46·7	24	31·2	11	15·5
1921–31	...	35	46·7	26	33·8	9	12·9
1911–21	...	37	49·3	34	44·2	3	5·1
1901–11	...	38	50·7	34	44·2	4	6·5
1890–1901	...	34	...	31	...	...	...
1885–90	...	36	...	26	...	...	...

MORTALITY

India's population growth during the last century has been conditioned mainly by the high but fluctuating death-rate. Famines, epidemics, the general insanitary environment and wars have contributed to the death-rate, though the last factor has almost disappeared in the last half century. During 'normal' years the death-rate has been consistently high because of the striking lack of public sanitation and hygiene, and widespread mal- and under-nutrition of the population. The death-rate rose distressingly during bad years, when epidemics and famine broke out due to the scarcity of food. It can be said with some truth that famine and epidemics alone have controlled the growth of India's population during the last hundred years.

The Indian death-rate is high—30 per thousand. The recorded death-rate was 24 per thousand for 1931 and 22 per thousand for 1940, but these are under-estimates because of incomplete returns.

However, this means that more than 10 million people die eve year in India. While the all-round death-rate is appalling enoug the death-rate by various age groups is equally unusual. T most disquieting factor of the Indian death-rate is the hig incidence of mortality among first-year infants, women in chil birth and women of the reproductive age group. The infa mortality rate is very high—nearly one-fourth of the babies bo die during their first year. According to official estimates, abo half the deaths among infants occur in the first month and, these, nearly sixty per cent in the first week. Mortality remai high throughout early childhood. About forty-nine per cent the total mortality in any given year is among those below t years of age, while the corresponding figure for England is on twelve per cent.

As for maternal mortality, the figures are equally shockin Sir John Megaw, when he was Director-General of Medic Services in India, made a random sample survey and arrive at the maternal mortality rate of 23.5 per thousand births. Th is, at least 200,000 women die every year during child-birth 100 out of every thousand girl-wives are doomed to die child-birth! In brief, out of every hundred babies born, on quarter die by the time they can reach their first birthda When the fifth birthday arrives, forty per cent have disappeare through death, and when the twentieth birthday is at hand on fifty per cent are left. By the sixtieth birthday only fiftee per cent survive!

But despite the present mortality rates, the average annu addition to the population of both the Dominions was fi millions. During the last two decades there has been, howeve a steady fall in the general mortality rate. A furth fall is bound to occur if the large-scale programmes for in proving the health of the country by various planning co mittees are effectively put into operation. It has been calculate that even a slight improvement in the present health conditio can save three million infant lives. When this is done, India population will increase by not five but eight million a yea And it is possible that the 43 million increase that took pla

between 1941 and 1951 could take place between 1951 and 1955! To repeat, a planned and purposeful control of mortality without a corresponding control of the birth-rate can only have disastrous consequences for India.

Today, however, the death-rate is the decisive factor in Indian demography. No comment is necessary on this inordinate and tragic loss of human lives. Nor is this all. There are many who do not die but who cannot be counted among the truly living, healthy, active and gainfully employed, because of the shocking nature of Indian morbidity.

Morbidity

If the available information on birth- and death-rates is somewhat incomplete and unreliable, that on the incidence of diseases is even more so. Rural India which shelters nearly eighty per cent of the total population has no adequate hospitals, clinics or other general or specialized medical services. Hence, there is no way of estimating the total morbidity of the population. Some information, however, is available for urban areas and such figures must be multiplied five or six-fold to get a complete picture for the Indian Union.

For instance, according to official sources, in normal years malaria is responsible directly for at least one million deaths every year. This really means that at least three million people die of malaria every year. If three million people *die* of malaria, it also means that at least ten million people *suffer* from it. The cost of treating the affected people—granting that they get some kind of treatment, expert or quack—and maintaining them in low health, and the indirect cost of man hours lost in the fields, factories and offices must be enormous. When the people have actually recovered from an attack of malaria their already low efficiency, due to lack of proper nutrition, is impaired further, making them less resistant to that catalogue of diseases that haunts the Indian countryside. Diseases ending in deaths are said to be selective in the sense that they wipe out the weaker element, but they cannot be said to improve the quality of those who narrowly escape death. If Indian morbidity statistics are

interpreted in this manner, the resulting picture is too grim need any comment.

Not only malaria, but cholera, kala-azar, small-pox, beri-be dysentery, tuberculosis, hook-worm disease, filariasis, guinea-wor and venereal diseases are ever present and take their due to Then, there are leprosy, blindness and partial sightedness, ment disorders and mental deficiency, and a score of other infirmiti All these are curable or, what is more important, preventabl more or less, but in India the lack of comprehensive ar organized medical services manned by an adequate number competent and qualified personnel, makes them very formidabl Curative medicine will only half solve the problem. As long the people's vitality and resistance to disease is low, due poverty, malnutrition and ignorance, and as long as the shockin insanitary and unhygienic environment of the towns and villag persist, any medical approach to this problem can only b fragmentary.

Despite the inadequacy of the return on the specific causes o mortality, a rough idea can be obtained from the following tab for a representative pre-war year, 1939. The general death-rat of 22.2 for 1939 was distributed as shown in the table. It highly probable that where deaths have been unattended to b doctors, as considerable numbers are, the returns usually li 'fever' as the cause of death. This lack of precise informatio nullifies the efforts of the public health department because th authorities, who are anxious to control the death-rate, do no know what exact causes contribute to the high death-rate.

	Cholera	*Small-pox*	*Fever*	*Dysentery and Diarrhoea*	*Respiratory Diseases*	*Injuries*	*All other causes*
Deaths per 1,000 of population ...	0·4	0·2	0·1	13·0	0·9	1·8	5·8
Percentage of Total	1·8	0·9	0·5	58·1	4·1	8·1	26·4

SOCIAL FACTORS

The demographic situation of any region is largely the product of its peculiar social characteristics affecting in their turn births, deaths and migration. The population problem in India can conceivably be very different if the social institutions of early marriage, universality of marriage, the social ban on widow remarriage and the joint Hindu family and other institutions and attitudes resulting in an adverse sex ratio, among others, did not exist. But as these institutions with a socio-religious tradition and sanction behind them exist and condition the lives of an overwhelming majority of the people, the demographic problem has become what it is today.

Early marriage and universality of marriage are dominant features of the Indian social scene. Indian girls attain puberty between the ages of twelve and fifteen and though often physically immature they are physiologically ready to bear children. And cases are not wanting where reproduction has begun at the age of fourteen or fifteen. The Report of the Age of Consent Committee and the Report of the All-India Women's Conference have estimated that nearly 50 per cent of the girls married in India are below the age of fifteen. While child marriage as such has largely disappeared, a majority of girls between 15 and 20 are in the married state. The girls in rural areas marry as soon as they reach puberty, begin bearing children early, and reduce the period of lactation, thereby shortening the intervals between child births with the disastrous final result of premature deaths.

The second factor is the universality of the married state. Everyone in India, sooner or later, gets married. It is a quasi-religious duty. As an individual's economic security is not a prerequisite to marriage and as there is no individual choice, by and large, in obtaining a partner, there is no economic deterrent to marriage. For a representative census year like 1931, we find that 467 males and 492 females out of every thousand were married. That is, taking into consideration all widows, some widowers, ascetics and mendicants, almost everyone of marriageable age was actually married. When factors favourable to the postponement of marriage, like prolonged education,

lucrative employment, eagerness for personal and social advancement, free choice in securing life's partners, and other considerations that operate normally in a Western society, will come to operate in India, it is difficult to say. But the sooner such considerations come to prevail, the easier will be the approach to solve some of India's social problems.

A third striking characteristic of the Indian social situation is the scarcity of females. There has been a deficiency of women in the Indian population within the knowledge of her regular census history. In 1941 there were only 934 females per every 1,000 males. In 1931 and 1921 the ratio was 940:1000. The sex ratio in England and Wales in 1940, for instance, was 1000:940 revealing a contrasting deficiency of males. The steady fall in the proportion of females to males has been going on in India since 1901 and the 1951 census does not reveal any significant change. Several explanations have been offered for this phenomenon. Some explain it as the result of relative under-enumeration of women. This is possible but during the last fifty years the efficiency of the Indian census organization has consistently improved but the adverse sex ratio has increased rather than decreased. Some argue that excessive masculinity is an index of 'racial decadence', but the sex ratio is more unfavourable in the North and North-west region—parts of present Pakistan—where the so-called 'martial races' live. We have little knowledge of what constitutes 'racial decadence' and still less scientific evidence of the causes and symptoms of such decadence. If there is any truth in this explanation, the virile people of the north-west must be the most decadent people. As we cannot have it both ways there seems to be little truth in this explanation.

Some others like the Census Commissioner for Bombay (1921) and the Census Commissioner for India (1931) have offered a biological explanation. According to the former, 'the Indian caste system with its exogamous *gotra* (sect) and endogamous caste is a perfect method of preserving what is called in genetics "pure line". The endogamy prevents external hybridization while the exogamy prevents the possibility of a fresh pure line arising within the old one by the isolation of any character not common to the

whole line'. The latter, accepting this view, comments, 'whether this (above) proposition be entirely acceptable or not, it may be conceded that if once a caste, whether as a result of inbreeding or some totally different factor, has acquired the natural condition of having an excess of females, this condition is likely to be perpetuated as long as inbreeding is maintained'. This explanation is at best plausible but we have very little knowledge about the presence of a genetic factor, if any, in the Hindu caste system. While there may be some truth in this explanation in the sense that excessive inbreeding is generally harmful, it does not explain the sex ratio *at birth.*

The available statistics tell a different story. Actually, between the ages of 1-5, India has an excess of girls and only at the next age group the sex ratio is reversed in favour of males. A more rational explanation for the paucity of females is that though the female infant is definitely better equipped by nature for survival than the male, the advantages she has at birth in India are probably neutralized in infancy by comparative neglect and in adolescence by the strain of bearing children too early and too often. As Hindu parents put greater premium on male children, they are apt to treat female children with relative neglect, especially when they are assailed by infantile ailments. This, coupled with early marriage and a high birth-rate, results in greater and early death among women. We have some comparable evidence in China that supports this view. Dr Ta Chen, discussing the sex ratio in the Kumming Lake region, observes 'It seems clear that in China relatively more female infants are born, but as they grow up, they make babies gradually catch up with them in numbers, evidently indicating a proportionately higher mortality among female children. This may be due to the fact that in the Far East generally and in China particularly parents usually put higher value on male children for the perpetuation of the family line and for the observance of filial piety. Thus, female children are unconsciously neglected, thereby leading to the higher death rate among them.'

The social ban on widow remarriage is yet another reactionary feature of Indian demography. The Indian demographic situation

is closely interwoven with social problems, for one undesirab social institution leads to another, and so on, in an endless chair This practice of 'socially sterilizing' the widows results in cor siderable disparity in age between husbands and wives. Sinc most widowers remarry and since they cannot marry widow they have to seek wives among girls much their juniors. Thi unequal combination from the point of view of age itself lead to an increasing number of widows, for the old husband passe away, leaving behind his young wife, a widow. And, of course she cannot remarry. The disproportionate sex ratio and th resulting deficiency of women keeps up the custom of earl marriage for girls. As bachelors and widowers have to tak brides of any age they can get, the disparity between partner is increased. This difference in age increases widowhood. Sinc widows cannot remarry, widowhood increases the already exist ing shortage of eligible brides, which means of course the paucit of women. Thus the vicious wheel whirls on!

Thus, the two significant facts about the wasteful balanc between births and deaths in India are the large decennial in creases in the population and the tremendous human cost a which this increase is being maintained in India.

Improvement of Agriculture

What is the way out? The problem of population has t be considered in relation to the means of sustenance, mainly foo supply. Nearly 70 per cent of the population is dependent o agriculture for a livelihood. As the mouths to be fed every yea increase, the area of productive land diminishes. That there i pressure on the land in India today cannot be denied. India agriculture is characterized by primitive methods of farming dependence on the vagaries of the monsoon, subdivision an fragmentation of land, consequent on the Hindu and Moslem law of inheritance (which enjoin the succession to immovable propert by all male heirs, usually in equal proportion) leading to un economic holdings and to excessive dependence by the majorit of the people on land for livelihood. Moreover, a quasi-medieva land tax system has created a large number of parasitic middle-me

who have come to possess undue rights on land, claiming a considerable share of the income arising from it without deserving it. The primitive technique of Indian farming is responsible not only for the low yield *per capita*, even when compared to countries like Japan and China, but also for the gradual deterioration of land with soil erosion and deforestation.

This does not mean, however, that there is no scope for improving Indian farms and their yields. According to 1939 official statistics, one-third of the cultivable land in both the Dominions lies idle—not fallow. According to the latest available statistics for the Indian Union for 1950 the cultivable waste is about 11 per cent of the total available land.

Agricultural area of the Indian Union (1950)	*Millions of Acres*	*Per cent*
Net area by professional survey ...	781	100
Area under forest	109	14
Area not available for cultivation ...	255	33
Cultivable waste other than fallow ...	88	11
Fallow land	54	3
Net area sown with crops	275	35

Thus, of a cultivable area of 417 million acres, only 66 per cent is sown with crops, 13 per cent is fallow, and no less than 21 per cent of land is cultivable but left waste. Then, there is land 'not available for cultivation'. About this land the Royal Agricultural Commission, India, (1926) said, 'It is difficult to believe that the whole of the vast area now classed as not available for cultivation, amounting as it does to 150 million acres or 22·5 per cent of the total area of British India (provinces) is either not available for cultivation or not suitable for cultivation'.

India has, therefore, not apparently exhausted the supply of her cultivable land, though such land is admittedly of an inferior quality. And what is cultivated appears to be eroded and exhausted because of the primitive technique of farming. With modern methods of agricultural science, of erosion prevention and soil reclamation, the cultivated land can be made to double its present yield and bring much of the so-called uncultivable waste

under profitable cultivation. Such an improvement is welcom but it will touch only a fringe of the problem.

While increased yield and more acreage of cultivation ar possible with the aid of science, they cannot by themselves affor a better standard of living to the Indian population, or completel solve the population problem, unless and until a substantial numbe of people now dependent on land are transferred to some othe productive employment as in industries.

Industrialization

Industrialization is often offered as a stock remedy for India population problems. A discussion of the possibilities of rapi and large-scale industrialization of India is beyond the scope o this study, but it must be pointed out that the basic prerequisite for industrialization, namely, raw materials, capital resources skilled labour, a market and technological 'know how' are availabl in India to a greater or lesser degree. The industrialization tha has taken place in India during the last thirty years, however has not helped to ease population pressure because it has bee piecemeal and unplanned and the percentage of population gain-fully employed in modern industry has been less than one pe cent of the total population. This haphazard industrializatio has also led to the decay of cottage industries, causing furthe unemployment. Only planned large-scale and rapid industriali-zation and the development of cottage industries—there need b no conflict between these two—can keep pace with the growin population and siphon off the surplus population from the over-crowded land to factories.

India's industrialization is important in the solution of he population problems for two reasons. It will increase the pro-ductivity of labour and create an abundance of badly neede commodities and services and transform the present economy o scarcity into an economy of abundance. Secondly, and this i probably more important for India, industrialization will encourag the development of new urban patterns of living which lead t the control of the high birth-rate. The 'Why' of this proces need not be discussed here, but this has been the experience i

the United Kingdom, the United States and the West generally, and Japan. There is no reason why India should not conform to this experience of other countries where industrialization has been accompanied by declining fertility.

MIGRATION

What about migration as a solution to the Indian population problem? As for the possibility of internal migration as a method of relieving the population pressure, there is not much scope either, because there are no empty spaces within the geographical confines of India and Pakistan. There are, of course, certain provinces and regions where the crude density per square mile is relatively low, as in Assam in India and in Baluchistan in Pakistan. During the last fifteen years, half a million immigrants went to Assam from other provinces, particularly Bengal. The provision of some admittedly inferior land for half a million people during a decade and a half, when the country's population increased by more than fifty million people, is only a drop of relief in an ocean of increase.

Certain patterns of inter-provincial migration established in India during the last thirty years show that inter-provincial migration has been constantly going on. The Assam Plantations, for instance, get their labour supply chiefly from distant Chota Nagpur. The nearby Bengal peasants are not attracted by these plantations, nor are they absorbed by the Bengal jute mills, but they move in to occupy the land in the Assam valleys. The coal mines in Chota Nagpur do not attract the people nearby and so labourers have to be recruited from the United Provinces and Bihar. We have no reliable figures, but these population movements are more of a seasonal migration and do not have any permanent effects. And then, when one group of people have moved out of a certain province, another group of people seem to be moving in. So the net result of such inter and intra-provincial movements does not seem to constitute any relief to the pressure on the land.

If migratory movements between different regions are to be explained as a response to the 'pull' of prosperity from less crowded areas, rather than the 'push' of poverty from overcrowded areas,

there are no regions in India where the standard of living the masses is markedly higher than in the rest of India. Th variations in the different levels of living in differen provinces and agricultural regions are not significant enough t encourage inter-provincial or inter-regional migration. After al migration, unlike water, is from a blighted region of low leve of living to a prosperous one of high level of living. There ar no conditions so absolutely unfavourable as to push people out side their regions if they have nowhere else to go. Thus, what ever internal migration that has taken place in the last thirty year in India has been in response to rigorous famines or the con struction of new irrigation projects and canals rendering th cultivation of more land possible. As severe famines or pros perity-promoting irrigation projects are not annual occurrences, th impetus to migrate has not always been present. Then there ar other factors that constantly nullify the urge to migrate. Con ditions of climate, language, diet, manners and caste restriction are not uniform all over India, and people moving from one part of the country to another may find themselves in a strange land, although they are among fellow Indians. Forsaking tradi tional homes and farms in favour of distant places is fraught with psychological difficulties, even though new homes may promise relative affluence.

In these circumstances, internal migration offers no substantia relief from population pressure. And the partition of the country which has already forced upon both the Dominions communal migrations renders the prospects of further inter-provincial mig ration dim.

Birth-control

The last and the most important solution is that of birth- control. It is too late in the day for India to discuss the pros and cons of birth-control. The arguments for and against con traceptives have been advanced *ad nauseum* and the scientific verdict has been in favour of it. Birth-control certainly has a vital role to play in India's population policy, along with the modernization of agriculture and the industrialization of the Indian economy.

Apart from the general rural conservatism of the masses that offers resistance to every reform, there is no organized resistance either by the government or the church as in some countries. Nor are the Indian religions opposed to planned parenthood. It will not be a hard task, therefore, to enlighten the public mind in India as to the benefits of birth-control. Once the public health officials begin hammering in its importance, it will spread even to the traditionally forgotten villages. Once Indian mothers are educated in the right belief that there is a scientific device to meet their desperate, albeit latent demands, birth-control can easily make headway. There are, of course, certain special difficulties which should be taken into consideration before planning a network of control clinics. It should be recognized that a majority of the Indian people live under backward conditions. Matters like bathrooms, running water, privacy, cheapness, reliability and the availability of contraceptives, and the illiteracy of women need attention. No matter what the obstacle, this reform must be pioneered.

Fortunately, this question has not been completely ignored in India. The authoritative Health Survey and Development Committee appointed by the Government of India observe, in their Report (1946), 'All of us are agreed that when child-bearing is likely to result in injury to mother or infant, there is every justification for the practice of contraception. In such cases it should be the responsibility of Governments to provide instruction regarding contraception in maternity and child welfare centres, dispensaries, hospitals and any other public institutions which administer medical aid to women. We also consider that the supply of contraceptive requisites should be made free of cost by the State to necessitous women when the practice is advocated for reasons of health. There is also unanimity among us in respect of State action in two other directions, namely, (1) control over the manufacture and sale of contraceptives, as in the case of food and drugs, and (2) assistance from public funds towards research for the production of a safe and effective contraceptive'.

But the most important need in India is to provide contraceptiv advice on *economic* grounds. Even this authoritative Committe could not shake off India's traditional obscurantism and includ poverty and the low standard of living as a pressing reason fo adopting contraception and limiting the size of the family.

The Indian National Congress, however, set up during th war a National Planning Commission under the Chairmanship o the present Prime Minister, the Hon'ble Shri Jawaharlal Nehru One of the Committee's resolutions recommends, 'In the interest o social economy, family happiness and national planning, famil planning and a limitation of children are essential, and the Stat should adopt a policy to encourage these. It is desirable to la stress as well as to spread knowledge on cheap and safe method of birth-control. Birth-control clinics should be established an other necessary measures taken in this behalf and to prevent th use or advertisement of harmful methods'. The resolution i significant enough but goes on to add, 'An eugenic programm should include the sterilization of persons suffering from transmissible diseases of a serious nature such as insanity or epilepsy'. This resolution was adopted by the National Planning Commission when India was not free and when it had no governmental authority. Now that the Chairman of the Committee is the Prime Minister of India, it is to be hoped that the resolution will not remain a pious sentiment on paper but will be translated into action. India's population problem is distressing enough as it is today and any delay will only accentuate the difficulty.

Human Conservation

In brief, despite the unprecedented scientific advances in the world during the last thirty or forty years, there is an enormous human loss in India from conception through old age. With all the available resources of scientific knowledge, skill and facilities for protecting people's health, and curing or alleviating the many ills and disabilities to which people are exposed, India continues to waste thousands of human lives.

Living today has become complex and difficult compared to conditions a century ago. The majority live in overcrowded

villages which have changed their faces but without any sanitary or medical facilities, and those who live in towns and cities find themselves in crowded conditions where earning a living, rearing children and running a home have become a formidable problem. Despite our belief in the intrinsic value of human life as a central tenet of our culture, we have offered resistance to certain reforms that encourage healthy and purposeful living. Human erosion and loss, therefore, persist long after they have become unnecessary because of certain traditional ideas and beliefs that still linger from the past when we were largely helpless against the diseases and dangers of life, and more or less ignorant of human needs and possibilities. Today, to some extent, much human waste is tolerated because of a fundamentally defeatist belief in man's helplessness against superhuman and mysterious social and natural forces that are supposed to control our social life and make human loss inevitable. Perhaps not a little of the tragic waste of human life is due to a conviction that human ills and miseries are well-merited punishments for our misdeed and guilt. Many a marvel of medical advance has been more or less opposed as interfering with divine purpose which had ordained human suffering. While belief in 'fate' as a controlling factor is slowly tending to disappear, it has not disappeared completely. These fatalistic beliefs persist in every society, but much more so in India, long after they have been rendered obsolete by scientific knowledge which is powerless to displace them. The way out in this matter is to give up clinging to archaic ideas and practices that are no longer valid according to present knowledge, nor compatible with democratic affirmation of human values. The sooner we do this the better and easier will be our approach to human problems of life, longevity and death.

FOOD REQUIREMENTS FOR HUMAN POPULATION IN INDIA

by

K. Mitra

(Directorate General of Health Services, Government of India, New Delhi.)

In this paper are considered the requirements of food, calculating on the basis of population estimates. It has been estimated that every unit of 10,000 of population may be reckoned as equivalent to 7,310.5 consumption units. According to Nutritional Advisory Committee, the composition of balanced diet (including all types of cereals, pulses, leafy vegetables and fats), should have an estimated calorie value of 2,700–3,000 depending upon the various occupation groups such as people with sedentary work, very hard work, pregnancy and lactation, etc.

Diet surveys in poor Indian homes have often recorded cereal intake of 18–20 ozs per C.U. Consequently, if every item in the non-cereal quota is short, then the total over-all deficiency in the cereals in the country is much above 10 per cent.

It has been estimated that if the present rate of increase of population is maintained the country requires by 1956 larger volume of production to an extent of 6 million tons of various items of food in addition to 48 million maunds of fluid milk.

Plans for food production in any country must take into account the requirement of food in terms of the various components for a balanced diet, the requirement of fodder for the maintenance of animals and provision of seeds for agricultural purposes. In the present paper, requirements of food for human population only will be discussed. An essential preliminary in this respect will be to estimate the needs of existing population and then to make extra provision for the likely increase in population in the near future.

Population Estimate

The population of the territory which constitutes the Indian Union today with the exception of the State of Jammu and Kashmir and certain parts of the tribal areas of Assam, has been enumerated as follows at the last six census operations:

Years	*Population (in millions)*	*Increase (in millions)*	*Percentage Increase*
1901	235·50		
1911	249·05	13·55	+ 5·8
1921	248·18	0·87	— 0·3
1931	275·52	27·34	+ 11·0
1941	314·83	39·31	+ 14·3
1951	356·89	42·06	+ 13·4

Owing to special conditions prevailing in Jammu and Kashmir actual enumeration of people in that territory was not carried out and this operation has never been attempted in some of the tribal areas of Assam. It is not intended to discuss in this paper the trend of population growth or the factors responsible for a decrease in population during the second decade of the present century. Growth of population depends on excess of birth over death and the balance of immigration and emigration. In the light of past experience it can be said that the migration factor plays but an insignificant role in the growth of population in this country.

Years	*Crude Birth-rate*	*Crude Death-rate*	*Excess of birth- over death-rate*
1901	34·7	20·5	5·2
1911	38·6	32·0	6·6
1921	32·3	31·0	3·1
1931	34·6	25·1	9·5
1941	32·1	21·9	10·2
1947	26·6	19·7	6·9
1948	25·5	17·2	8·3
1949	26·7	16·0	10·7

A casual glance through the crude birth-rate and crude deat rate figures will indicate in no uncertain terms that if the preser trend of diminishing death-rate continues without a marke decrease in the birth-rate, a population growth of at least I per cent may be expected during the next decade, on the ex perience of the average of population increase during the las three intercensal periods.

Estimate of Consumers

For calculating the food requirements with a reasonable degre of precision the different age and sex groups have to be reduce in terms of hypothetical adult man value or 'Consumptior Units' because the calorie and other nutritional requirements ar ordinarily prescribed in terms of such consumption units. Ag structure of the population as enumerated in 1951 Census is no available yet, consequently we have to fall back upon the previou census figures. During the 1941 census operations age table were not prepared for the whole of undivided India but they were actually enumerated for a few selected areas on a random sample or Y-sample basis. In 1931 census report, however, the age structure of the population has been given. The age structure of population for some of the areas as revealed by 1941 census figures on Y-sample groups did not differ materially from the age structure of the population for the whole of India as shown in 1931 census table. The respective figures are given below:

	Proportion 1931 Census		*Proportion 1941 Census (in Y-sample Groups)*
0	309·5		
1	287·5		
2	313·9	1,534·6	1,355·3
3	316·9		
4	306·8		
5	1,304·2		1,442·4
10	1,162·9		1,095·6
15 and over	5,998·3		6,104·8
	10,000		10,000

The population movement brought in the trail of the partition of the country in 1947 may have changed the population structure to a certain extent but it is expected that the change will be not of such a magnitude as to cause a very wide deviation in the structure. However, age structure of population as shown in 1931 table has been taken as the basis of food requirements. The League of Nations had suggested certain calorie coefficients for calculating the man-value consumption unit or hypothetical adult male in any population group. These coefficients have been given in two-year age groups up to the age of 14 over which a man or a woman is reckoned as an adult. The respective calorie coefficients of the age structure from 1931 population is given below:

Age	*Consumption Unit*	*Age Structure*
From 0–2years	Nil	598
Over 2 years and up to 4 years	0·3	631
Over 4 years	0·4	556
Over 6 years	0·5	526
Over 8 years	0·6	528
Over 10 years	0·7	500
Over 12 years	0·8	455
Over 14 (man)	1·0	3,201
Over 14 (woman)	0·8	3,005
		10,080

According to this computation we find that in India every unit of 10,000 of population may be reckoned as equivalent to 7310.5 consumption units. The estimate thus arrived at may be used for the enumerated population of 1951. In making estimate of requirements for the future quinquennial or decennial periods, necessary adjustments may be made.

Target Figures for Different Foods

Nutrition workers in India have arbitrarily, though almost unanimously, accepted the convention that classes of foods may

be divided into nine groups and they are: (1) cereals, (2) pulse (3) leafy vegetables, (4) root and other vegetables, (5) fats ar oils, (6) milk and milk products, (7) flesh foods which inclu fish, meat and eggs, (8) fruits and nuts, and (9) sugar ar jaggery. The spices have been deliberately excluded from con putation as the individual requirement of spices is small and th costlier spices are all imported from abroad. The spices produce in India consist, mainly, of turmeric, coriander, rape or mustar seeds and pepper. The composition of a balanced diet, a suggested by the Nutrition Committee, for an adult male as follows:

		Estimated calorie value
Cereals	14 ozs.	1,400
Pulses	3 ,,	300
Leafy vegetables	4 ,,	60
Other vegetables	6 ,,	60
Fats and oils	2 ,,	500
Milk and milk products ...	10 ,,	250
Flesh foods	4 ,,	125
Fruits	3 ,,	100
Sugar and jaggery	2 ,,	225
		3,020

In making the estimates it would be appropriate to indicat the number of vegetarians or non-vegetarians in the population but this is a subject on which we have very little factua information. On a very liberal estimate the number of vegetarians *i.e.*, those who would refuse to take flesh food of any type ma not exceed 30 per cent of the total population. For vegetarians therefore, a provision of extra 4 ozs. of milk has to be made i a balanced diet in lieu of flesh foods which may be compute as 3 ozs. of meat and fish inclusive of bones and one egg only.

The fixation of calorie requirements of individuals in an country, becomes at times, a matter of opinion and at times c

controversy within certain limits. It would not at all be surprising if between the estimated figures of one expert and another of equally good standing a difference of as much as 10 per cent be discovered. Mainly because one may be veering round the minimum requirements and the other in the neighbourhood of maximum.

At a meeting of the Nutrition Advisory Committee held in New Delhi in November 1944, the level of calorie requirements for Indians was fixed after a good deal of discussion. According to this Committee the requirements are as follows:

Life led	*Calorie requirements of man*	*Calorie requirements of woman*
Light or sedentary work	2,400	2,100
Moderate work	3,000	2,500
Very hard work	3,600	3,000
Pregnancy	Nil	2,100
Lactation	Nil	2,700

It will thus be seen that in order to suggest an average daily calorie requirement per consumption unit one has to take into account the age, sex and occupational distribution of the population. The actual difficulty arises in computing what percentage of population should be regarded as sedentary, and what percentages as doing moderate work and as engaged in very hard work. Such figures for the country are not available. Further, it is not possible to determine precisely as to which are the occupations that may be classified under 'hard work' and which of them under 'moderate work'. It is common knowledge that India is industrially a very backward country. It would not be wrong to presume that about four-fifths of the total working population is engaged in agricultural work to earn their livelihood and about one-fifth only employed in vocations requiring hard manual labour. The number of old men needing less food than adults is proportionately much smaller owing to a limited span of life as compared with other countries. Reasonably precise figures either of the working population or of old persons are

not available. We may presume, on a very conservative estimate that overall requirement of calories per day per consumption unit may be reckoned as 2,600. To this figure has to be added another 10 per cent to account for the spoilage caused by rodents insect pests and other unavoidable losses beginning from the harvesting of the grains to the time till such foods are actually consumed. Consequently, provision has to be made for supplying each consumption unit with 2,860 or 2,900 kilo-calories per day. This figure should be considered as the barest minimum level below which it would be risky to base our calculations for the calorie target.

A point which has sometimes been raised in this connexion is whether people in tropical climate need as many calories as people living in temperate or colder zones. A few basal metabolism investigations carried out in India have shown that our metabolic rates are slightly slower. One does not know whether chronic underfeeding in our country is responsible for lower rates. But the fundamental fact cannot be denied that for performance of the same type of manual labour a resident in the tropics needs as much food as a resident in a colder climate. The calorie value of a balanced diet as recommended by the Nutrition Advisory Committee is reckoned at 3,000 whereas according to the table of calorie value recommended it should be at 2,900. This difference is not as great as it seems. No allowances have been made for the basic physiological fact that in adolescent stage more calories may be consumed than the 2,600 limit and the requirements for some of the foods such as milk and flesh foods may be more than that prescribed for adults. Consequently, in making the estimates of requirements for different foods the above figures should be used as basis of calculation.

The total requirements for different kinds of food for human population enumerated on 1st March 1951 is shown in Table I. Of the items shown in the table, the one pertaining to milk may be difficult of attainment within the near future unless whole milk powder is imported from abroad. Consequently, one would like to suggest that the distribution of milk available in the country should be so controlled as to confine its consumption

amongst the vulnerable group consisting of children and mothers.

It is not known whether the oft-quoted statement in the press about 10 per cent shortage of cereals is based on the composition of the balanced diet advocated by the Nutrition Advisory Committee and suggesting an intake of 14 ozs. of cereals. If the shortage has been calculated on the basis of 14 ozs. of cereals per consumption unit then the estimates are widely off the mark. It is common knowledge that if the proper non-cereal quota is lacking in the diet more and more of cereals are consumed. Diet surveys in poor Indian homes have often recorded cereal intake of 18.20 ounces per C.U. Consequently, if every item in the non-cereal quota is short then the actual deficiency in cereals in the country is much above 10 per cent.

It would be interesting to know the additional requirements for the different items of food in 1956 if the present rate of population growth is maintained. These are: cereals 2.4, pulses 0.5, leafy vegetables 0.7, other vegetables 1.0, fruits and nuts 0.5, sugar and jaggery 0.3, ghee and vegetable oil 0.3, flesh foods 0.7 million tons in addition to 48 million maunds of milk. Even if people take to measures for birth-control seriously, there is very little chance of reducing our requirements in the next quinquennium.

TABLE I

ESTIMATED REQUIREMENT OF FOOD FOR 1951

Items of food	Consumption unit	(1) Vegetarian population 107·07 Millions 78·27 ,,	(2) Non-vegetarian population 249·82 Millions 182·63 ,,	Total of (1) and (2)
Cereals	(in 000 tons)	11,160	26,039	37,199
Pulses	,,	2,391	5,580	7,971
Leafy vegetables	,,	3,188	7,440	10,628
Non-leafy vegetables	,,	4,783	11,159	15,942
Fruits and nuts	,,	2,391	5,580	7,971
Sugar and jaggery	,,	1,594	3,720	5,314
Ghee and vegetable oil	,,	1,594	3,720	5,314
Meat, fish and eggs	,,	...	7,440	7,440
Milk	(in 000 mds.)	312,468	520,781	833,249
Eggs	The calculation leads to an astronomical figure.			

FOOD, POPULATION AND RATIONING SYSTEM IN INDIA

by
Shri Ranjan
(*Professor, Department of Botany, Allahabad University, Allahabad*)

Food and Population are related subjects and the adequacy of the former cannot be determined without due consideration of the country's productivity. Productivity, on the other hand, is largely dependant upon the people of the country. It has been said that India's food shortage is partly due to the increase in the population of India. But, when we compare the distribution of population per square mile in different countries, it is seen that India has only 220 people per sq. mile as against 742 per sq. mile in England. Thus, it becomes clear that India is not over-populated, but the productivity of the country is low. This is due to the fact that agricultural and industrial development of the country have not kept pace with the increase in population. The available land resources for the development of agriculture and industry in the country are very large. It requires, therefore, scientific utilization of all the available resources of the country and modernizing our methods of agriculture. The procurement of KHARIF *crop and derationing of the* RABI *crop are suggested. To augment the procurement of food grains the land revenue could be realised in the form of* RABI *grains. These two measures would increase the quantity of food grains procured in the country. Alongside these measures, the 'Grow more Food' campaign should be intensified and all available land should be brought under cultivation. The system of intensive cultivation of food crops should be followed. Intensive cultivation cannot be done without the aid of Government. Bearing in mind that research work in future should be planned according to the most pressing needs of agriculture in the country, all work should be properly*

co-ordinated and the results thus achieved should be given full publicity.

For some time past, the world has been thinking in term of food and nutrition. The food situation in many parts o the world is serious. The shortage of food and its resultan consequences have loomed large in important internationa gatherings culminating in the formation of the Food anc Agriculture Organization of the United Nations. It would b superfluous to stress the precarious nature of our food productio and the consequent instability of our agricultural economy.

The Question of Over-population

With the spectre of famine haunting India, the questio whether or not the country is over-populated has been holdin the attention of the people. Indian economists and politician have expressed in no unmistakable terms the view that th country is definitely over-populated and they have based thei conclusions on the Malthusian principle, according to which while production increases in arithmetical progression, population increases in geometrical progression, thus overtaking production at a rapid rate. Therefore, unless population is kept properly checked by the promulgation of neo-Malthusian methods, it is liable to endanger the food security of the country.

But, such a view, expressed without any backing of accurate statistical data and with an imperfect understanding of the basic laws which govern nature and population, is not only erroneous in theory but is likely to lead to mischievous results in practice. It is mischievous because, while breeding despondency among the people, it preaches that population needs drastic restriction.

It is, therefore, a matter of immediate importance that the question of the population of this country be carefully examined. It can only be treated in relation to production, economic advance-ment, size of the country, moral and political development and other factors. These would be useful investigations for the purpose of studying the question of population. Therefore, those who treat this problem without regard to these related factors get a perverted view of the entire question.

Population and Production

As mentioned above, population and production are related subjects. The relative magnitude of the former cannot be determined without due consideration of the country's productivity. Productivity, on the other hand, is largely determined by the people. Therefore, production and population are inseparably related. When we view the subject of population in this light, we find that practically no limit can be set to the increase in numbers. For, the limit can only be determined by the limit of human ingenuity. Because, so long as inventions continue to take place and production increases by leaps and bounds, the operation of the Malthusian principle can be kept in abeyance; and it is difficult to assess the limit of human ingenuity.

India may appear over-populated if viewed in its present economic state. Radhakamal Mukerji observes, 'The race between population and food supply in India has been neck to neck since the beginning of the twentieth century, but since 1937–38 the food production has been outstripped by population growth'. In the absence of correct statistical data it is difficult to say whether the country is in this sense over-populated. Even supposing that in its present state India is really over-populated, the true remedy does not merely lie in advocating measures to restrict the growth of population, but also in adopting means to augment production, *i.e.*, greater employment of modern methods of production.

Population of European Countries and of India

When we compare the population of India with that of western countries, we find that Europe has far more people per square mile than India. The figures, given below are illustrative:

England	...	...	**742 per sq. mile**
Belgium	...	...	**688 ,, ,,**
Germany	...	...	**358 ,, ,,**
India ...	...	...	**220 ,, ,,**

What is the secret of the fact that the first three countries mentioned above are not considered over-populated while there is

already a cry of over-population in India? The fact lies in the all-round economic advancement of those countries. Before the war the energy-index per capita according to Dr Saha (*Nature*, 1945) from inanimate sources was 2,000 for Britain and 2,500 for the U.S.A. In India it amounted to only 30. U.S.A., England, Germany, Belgium, etc. are all highly industrialized countries and pursue a very intensive system of cultivation. In India, on the other hand, manufacturing industries have only just made their appearance and agriculture in vast tracts of the country consists in the scraping of the soil with antiquated wooden ploughs. The utilization of modern scientific methods of agriculture is almost non-existent. Hence, the output both from the land and industries is not on a par with that of European countries and consequently drastic measures are advocated to restrict population to restore the equilibrium. This certainly is one approach but not wholly satisfactory. As Ruskin says, 'The true wealth of a country lies not in its output but in its men'; the true and proper course lies in the harnessing of all means to further India's economic advance.

India's Economic Advantage

India has a distinct economic advantage over other industrialized countries in having vast tracts of potentially fertile lands. Industries, whatever they may be, are all ultimately dependent on the wealth of the land. Those countries which are not self-sufficient in the matter of raw materials for their industries are at a disadvantage because if their supplies of raw materials are cut off, the industries would have to close down. India has no such fears, for it has immense potential resources awaiting exploitation. Besides supplying raw materials to industries, the large tracts of land are capable of producing enough food to meet the home demand if agriculture is practised on a scientific basis, *i.e.*, if modern implements are used and intensive cultivation is adopted. Further, there should be a proper adjustment and allocation of land available for cultivation of food and money crops. The prosperity of a country ultimately depends on a harmony of these two types of crops. A money crop in excess of

its demands in the market ceases to be an asset. Therefore, balance between the two is necessary and it should be so maintained as to be adjustable to changing circumstances.

The World War II brought in its trail the famine of 1943 in India by cutting off imports of rice from Burma, and focused the attention of the people of India to the immediate urgency of the food situation. The position has grown worse since. It is estimated that in 1943 alone India was faced with a deficit food supply to the extent of 4 million tons. This would imply that 70 millions out of a population of 400 millions went without food. Actually, however, it means that a large section of our people did not have enough food to their share. Since then, our annual deficit of food continues to be alarming. Though some part of this may be due to the defective system of transport, storage and hoarding, a large part is due to actual shortage in output. After partition some of our most fertile lands have gone to the share of Pakistan and the net result of the exchange of population that followed has been a further addition of a substantial population to our portion of the divided country.

Rationing System

(i) *Procurement of Kharif instead of Rabi*

In view of the overall shortage of food, rationing has been introduced by the Government for a section of population. Unfortunately the present rationing system has greatly upset the balance between the food-crops and money crops and has thus indirectly become an important factor for India's huge deficit in crop-production. Before the War the farmers in general (farmers in N. India) subsisted largely on *kharif* crops, *viz.*, *jowar* and *bajra*, and also to a certain extent on crops like *kodu*, *sanwan*, etc., while *rabi* crops, *viz.*, *wheat*, *barley*, etc. were sold largely in the urban market and these were actually used by farmers as their money crops. Wheat grains were then sold at about Rs 3 a maund, while *jowar* and *bajra* were sold at about half the price. Since the introduction of rationing, the picture has completely changed. Today the *kharif* crops are selling at approximately the same rate as the controlled *rabi* crops even at the ration shops. As a

consequence, the farmer uses up the *rabi* crop for his own food and utilizes part of the *kharif* and chaff (*bhusa*) for cash by selling them in the urban market. In the urban population also the number of *rabi* crop consumers has gone up considerably because labourers and the lower classes do not forego their superior wheat or barley or rice when it is in their quota and especially when it sells at almost the same price. But this upsetting of the consumption balance between '*rabi*' versus '*kharif*', as a result of rationing, does not mean the abandonment of the rationing system altogether as has been advocated. For, although, in the ultimate analysis, by derationing, the prices after an initial rise, are bound to fall when they reach their new adjusted levels, yet no Government can undertake the risk of the disruption of agricultural economy, even though it may be for a short period in the early stages. The real remedy therefore lies in introducing a system of rationing wherein the *kharif* crops are procured in December and controlled at substantially lower prices and the *rabi* crops are partially derationed. In the urban areas the lower classes should then be given the choice between purchasing the comparatively dearer wheat and barley and the cheaper *kharif* crops which they will then almost certainly prefer to purchase. In addition, rationing should be abolished for persons earning more than Rs 1,000 per month who should be allowed to buy their food requirements in the open market.

(ii) *Kisht or land revenue to be realized in the form of rabi grains.*

The present unpopular procurement system is also harmful in the same way. Since the farmer is, at present, free to cultivate whatever he likes, he prefers to cultivate only as much *rabi* crop as he needs for his own requirements. For money he now grows the *kharif* crops which he can produce with much less labour, and dispose it off without harassment from the Procurement System; by doing so he ultimately earns as much money as he would have earned otherwise. The Government should therefore abandon the procurement of *rabi* grains, and instead realize the revenue in the form of *rabi* grains. A suitable proportion of the farmer's

potential *rabi* produce should be fixed for this purpose. In this way the farmer will be forced to cultivate and give part of the produce of his *rabi* crop to the Government and if the same is realized in four instalments the problem of pre-monsoon large-scale storage will resolve itself by being distributed in the many small farmers' stores and the burden of partial storage will shift from the Government to the farmer.

As a result of these measures, one can safely say that the two complementary sections of our population will again start consuming the two complementary portions of our agricultural produce and it is not improbable that even some of our hard-pressed middle class people would then prefer the cheaper *kharif* grains.

Grow More Food Campaign

Alongside these measures for the conservation and proper utilization of our food supply, we should also concentrate on building up our food resources and in producing more food. Some means should be found for eliminating this continuous shortage. An increase of area under cultivation is one of them. But the pressure of population on the land is so much that it is hardly possible to expect spectacular results in this direction. The total area in which cultivation is a profitable proposition, but which is not so utilized, is negligible in relation to population. Therefore, in order to bring more land under the plough, agriculture must be extended to the lands that usually lie waste or fallow and on which cultivation is, at present, not profitable. The factors which tend to withhold such lands from cultivation require to be eliminated. Lack of water may be one; excessive water may be another. Again, the land may be infested with weeds or the nature of the soil may itself stand in the way, *e.g.*, its low fertility, alkaline nature etc. None the less, as a result of the 'Grow More Food' Campaign, the extension of agriculture to lands which were usually left fallow has been materialized to some extent. It is hardly necessary to emphasize that expansion of agriculture should be maintained and these lands should not be allowed to fall fallow again.

Intensive Cultivation

But the expansion of agriculture should not overlook th possibility of intensive cultivation. It is common knowledge tha the crop yields in India stand at a much lower level as compare with those of some other countries in the world, *e.g.*, the averag yield of rice in India is only 988 lb. per acre, while in Chin it is 2,433 lb. and in Japan 3,070 lb. Comparative data fo wheat are 888 lb. in India, 989 lb. in China and 1,350 lb. i Japan. It would seem, therefore, that much improvement i possible in India so far as yields are concerned.

It is not only desirable but indispensable that definite an clear-cut schemes be laid down for the improvement of agri culture. No scheme of agricultural improvement can materializ unless there is an intimate contact between the Government scientists and the farmer. Here again, problems of organizatio arise which are not confined to science, but which will largely depend upon the attitude of the Government towards scientific knowledge. Thus, if the relation between agriculture and the Government is to be well organized, the most important step to be taken by any National Government should be to see that the present Government agricultural machinery is strengthened and made to work in a more co-ordinated and effective manner. Scientific research is a very important branch and has been gravely neglected in the past. In the absence of a suitable central organization stray scientists have been carrying on researches in agriculture in various parts of the country. They are faced with many difficulties not the least of which is finance. But research work in future should be planned according to the most pressing needs of agriculture in this country. All work should be properly co-ordinated and the results thus achieved should be given full publicity and brought home to the farmer who will ultimately put them into practice with benefit to himself and to the country.

FOOD AND POPULATION PROBLEMS IN TRAVANCORE-COCHIN STATE

by

V. K. R. Menon

(*Commissioner of Civil Supplies, Travancore-Cochin State*)

Travancore-Cochin which is approximately 8,500 sq. miles in area has an inhabitable area of nearly 4,250 sq. miles. The population of Travancore being about 92.6 lakhs, the average density of population in the habitable area comes approximately to 2,000 per sq. mile. Since 1875, the density of population has more than trebled itself and during this period the production of cereals in this area has not kept pace with the increase in population.

Unlike in Mysore, where a variety of dry crops can be grown along with paddy, only paddy is grown on an extensive scale in Travancore-Cochin. In addition, cocoanuts are grown widely. The average production is estimated at 3 lakh tons of rice while the demand is about 13½ lakh tons. Thus, the gap of 10½ lakh tons has to be made up either by imports or by supplementary foods. Since 1875, continuous efforts have been made to increase the area under food crops and also production of supplementary foods such as yams, bananas and tapioca. These have met with great success. Irrigation schemes were also undertaken. Manuring has become popular.

From the figures of population and of production of foodgrains it becomes clear that the state can never hope to become self-sufficient in foodgrains. Thus, growing of alternative food materials becomes important. Tapioca which is called the poor man's food is grown in plenty in the State. Recent researches have revealed that tapioca can be converted into synthetic foodgrains which have got a great future in this country.

Travancore-Cochin State is a long thin strip of land extending from Cape Comorin to Ponnani. It is nearly 250 miles long and

40 miles broad. It is approximately 8,500 sq. miles in area, o which nearly 50 per cent is comprised of hills and back-water The 1951 Census reveals that a population of 92.6 lakhs is crowde within the habitable area of nearly 4,250 sq. miles, so that th average density of population is approximately 2,000 per sq. mil in this area. The economic richness of the country, derived fror its varied money crops, has made it possible that this land ca maintain a population well in excess of what is possible in othe States like Madras or Mysore. It cannot however be denied tha the present population has far exceeded the optimum limit. Th population in the State has risen alarmingly in the 20th century The population during the 1901 Census was less than 40 lakhs which was lower than the then population of Mysore. Th density of population was then about 420 per sq. mile. It was a low as 326 in 1875. By 1941 the population had outstripped tha of Mysore. As per the present Census the density of populatior is over 1,000 per sq. mile. It will thus be seen that the populatior has more than trebled itself during the last 75 years.

It is very doubtful whether even the large and varied economi resources of the country will be able to maintain this populatior above subsistence level for a long period. The inflatory tendency brought about by War has created an artificial prosperity, which has largely contributed to the 23 per cent increase of populatior during the last decade. When the next slump comes, wide-spread unemployment, with all its unpleasant repercussions, wil be inevitable.

However, we are at present concerned only with the reper-cussions of the increasing population on the food problem of the State. Lying as it does, between the Western Ghats and the Arabian Sea, the State enjoys the benefits of two monsoons; the average rain-fall being 60–70″ during the South-West Monsoon and 20–30″ during the North-East Monsoon. The rain-fall is as high as 160–200″ in the hill-stations like Devicolam and Peermede, and as low as 20–30″ at the southern extremity of Cape Comorin. The torrential rain-fall, which has washed away most of the fertility in the central and northern portions of the State, has however made the cultivation of two crops possible in

the major portions of the paddy lands in the State. The Kodayar Irrigation Project has extended this possibility to the southern area as well.

Unlike in Mysore, where a variety of dry crops are grown along with paddy, only paddy is grown on an extensive scale in the Travancore–Cochin State. The fields are water-logged during the monsoons and are not capable of being utilized for the cultivation of seasonal cash crops like cotton and groundnut, or of dry crops like Cholam and Ragi. Part of them can, however, be converted at considerable expense into cocoanut gardens or house-sites; and this process is going on, because while cocoanut is fetching very attractive prices, the cultivators claim that the statutory price fixed for paddy is uneconomical.

The lands were settled during the last decade of the 19th century. As per the settlement register there were eight lakhs acres under paddy. A sizeable portion of this acreage was sub-marginal in productivity. Large areas adjoining the back-waters were affected by salinity and noxious weeds. Areas adjoining the hills were affected by the attacks of pests and wild beasts. The yield from these eight lakhs acres was in any case inadequate to maintain a population of less than 30 lakhs, and large imports of rice were being made from Burma in high-masted sailing ships, which touched Cochin during the favourable weather. Famine was endemic in South Travancore, where the Kodayar Scheme was not yet put into operation.

Since 1875, continuous efforts have been made to increase the area under paddy, to increase the yield per acre and to increase the production of supplementary foods like yams, bananas and tapioca. The attempt to increase the acreage has at best served only to compensate the continuous decrease in acreage brought about by the conversion of marginal paddy lands into garden-lands and house-sites. The latest estimate gives the area under paddy at slightly less than eight lakhs acres, in spite of the herculean efforts at increased food production.

The attempt to intensify production has met with greater success. Innumerable minor irrigation schemes as well as schemes of a more ambitious nature like the Kodayar Scheme, the

Chalakudy Diversion Scheme, and the Peechi Scheme, have mor or less assured water supply to a major portion of the acreage unde paddy. Manuring has become popular. The cultivators hav also become conversant with the elements of pest-control. Th average production is estimated at 3 lakhs tons of clean rice derived from 4½ lakhs tons of paddy.

But the figures of population and of production make i distressingly clear that the State can never hope to become self sufficient in foodgrains. The alternatives are either to develop the cultivation of supplementary foodstuffs or to take steps to se that adequate imports are assured even during times of War, a in the case of countries like England or Belgium. The assuranc of import is a matter beyond the control of the State. It i doubtful whether the Indian Union itself can give such an assurance. We have, therefore, to fall back on the production o supplementary foodstuffs, of which tapioca is the most prominen item.

Tapioca was introduced into the State by the Portuguese Ad venturers at the beginning of the 16th century, and continued t be sporadically cultivated for the next 200 years. It came int prominence towards the middle of the 19th century, by which time less toxic varieties had been evolved. The poor people had also got accustomed to a diet which consisted mainly of tapioca with rice gruel, fish, or *chatni*, as a side dish.

Assuming that an adult consumes one pound of food per day approximately one ton of food is required to feed 6 adults pe annum. 13½ lakhs tons of foodstuffs are therefore required t feed the State's population equivalent to 81 lakhs of adults 3 lakhs tons rice is internally produced. An average of 3½ tons foodgrains have been imported per annum during the last four years. The gap of 7 lakhs tons has therefore been made up of supplementary foods, the major portion of which must undoubt edly have been tapioca. It is now being grown extensively throughout the State.

It will be inappropriate if I were to end this note without a reference to the very laudable efforts that are being made by Dr Subrahmanyan to manufacture synthetic rice from tapioca

and make it available in a cheap and nutritious form to the people of my State. The technical details of the Scheme are too well-known to be discussed at length here. I hope most of you have tasted and enjoyed the very palatable dishes made out of synthetic rice. The production and distribution of this commodity on a mass scale involves problems of storage, of transport and of prices. Most important of all, in my opinion, is the problem of prejudice against any substitute for rice, which is inherent in every South Indian; but finds expression in a bitter if not vitriolic form from the pens of some of my country-men, who have not troubled to study the very serious problems of food and population of the State. Compared to the local production in an average year, the State's imports have to be 116 to 120 per cent of the internal production, while the ratio for Mysore is 12.5 per cent, and that for Madras less than 6 per cent. The citizens of Mysore and Madras can perhaps afford to be discriminating in their tastes and insist on a diet composed mainly of cereals or millets. But the citizens of Travancore–Cochin State can ill-afford this luxury. With the storm clouds of War lowering on the horizon, it is high time that they decide on the form in which tapioca is to be consumed. Tapioca by itself forms an unbalanced diet. It is mostly grown on the hill-slopes where fish is not easily available. Tapioca rice has adequate protein content and forms an ideal diet to the poor. Its future is very bright provided it can be mass-produced at an economic level, and provided that sustained efforts are made by the people of the country to remove the prejudice that now stands in the way of its popularity.

Conclusion

The food problem of the Travancore–Cochin State is rendered unique by the fact that its very limited cereal production has virtually reached the maximum limit, while the pressure of population on land is increasing at an alarming rate. Its normal cereal import amounts to 120 per cent of the gross internal production of rice and nearly five times the quantity procurable even under a Monopoly Scheme of Paddy Procurement. The

population of this State has therefore to depend either on imports, whether from India or outside, or to turn to alternative foodstuffs. The neighbouring State of Madras may not be in a position to guarantee this supply for the next two decades. The import position can become precarious in times of war. It may be safer for the State to fall back on her tapioca reserves. Whether this tapioca is to be consumed like other roots, or as Synthetic Rice, is a problem which the people have to solve by themselves.

STATE	*Area under cereals (Acres)*	*Average annual Production in 1,000 tons*	*Average annual Procurement in 1,000 tons*	*Imports in 1,000 tons*	*Statutory rationed population*	*Proportion of imports to total production*
TRAVANCORE-COCHIN STATE						
Rice	...	300	70	300	70,58,000	
Other grains ...	...	2	...	50	(Throughout State-urban and rural)	116%
Total	8 lakhs	302	70	350		
MYSORE						
Rice	...	250	75	40		
Other grains ...	...	550	25	60	12,04,600 (4 towns)	12·5%
Total	39 lakhs	800	100	100		
MADRAS						
Rice	...	4,500	1,300	150	59,28,000 (73 towns)	5·63%
Other grains ...	...	2,800	80	250		
Total	217 lakhs	7,300	1,380	400		

STATISTICAL APPROACH TO FOOD PROBLEMS

by

F. J. Noronha

(*Professor, Maharaja's College, University of Mysore, Mysore*)*

Statistical analysis and the logic of inductive inference are becoming increasingly important in many branches of scientific research and technology. In this paper some of the applications of statistical methods in the elucidation of food problems in our country are discussed. The problems include: forecasting food requirements and estimation of crop yields, statistical techniques in agricultural experimentation, problems in nutrition, food-canning, etc.

STATISTICAL analysis and the logic of inductive inference are becoming increasingly powerful tools in many branches of scientific research and technology. The object of this paper is to indicate some of the applications of statistical methods in the elucidation of food problems in our country.

ANALYSING THE FOOD SITUATION

In order to obtain a clear idea of the food position and to view the problem in its proper proportions one has inevitably to resort to statistics, and it is a matter of primary importance that the data collected are accurate and reliable. The collection of agricultural statistics is itself a problem of great difficulty. In the U.S.A., the three major parts of the statistical programme of the Department of Agriculture are: (1) to provide statistics which will permit adequate differentiation among the variety of situations and problems included in American agriculture; (2) to fill in gaps that still exist or may develop in the statistics of agriculture and food; and (3) to effect improvements in the techniques of collecting and analysing statistical data.[1] In our country the position is further complicated by the existence of numerous small holdings scattered over wide areas of the country. Also methods practised in other countries, such as the questionnaire

* Now, Professor of Mathematics, Engineering College, Bangalore.

method, are not practicable here due to illiteracy and other psychological factors. Hence improvements in the methods of collecting data, which is the first step in any statistical process, must always form one of the important items in the programme of our agricultural organizations, and statistical techniques, such as that of random sampling in the estimation of crop yields, may be employed with advantage. This has the additional advantage of providing a measure of the extent to which the estimate is likely to be in error.

I shall first present a picture of the food situation in our country as I view it from the data published by the Department of Agriculture.

The following table gives the quantities of foodgrains produced and imported during the past five years.

TABLE I

Production and Imports of Foodgrains into India 1945-46 to 1949-50. (Thousands of tons)

		1945-46	*1946-47*	*1947-48*	*1948-49*	*1949-50*
Rice	Production	18,463	19,856	19,534	21,725	21,913
	Imports	46	326	485	868	...
	Total	18,509	20,182	20,019	22,593	...
Wheat	Production	5,912	4,745	5,389	5,472	6,110
	Imports	804	1,345	853	1,309	...
	Total	6,716	6,090	6,242	6,781	...
Jowar	Production	5,577	5,277	5,730	5,013	5,760
Bajra	Production	2,681	2,667	2,764	2,129	2,554
Maize	Production	2,052	2,035	2,127	1,719	1,959
	Imports	...	305	239	283	...
	Total	2,052	2,340	2,366	2,002	...
Ragi	Production	1,170	1,476	1,455	1,455	1,438
Barley	Production	1,958	2,414	2,488	2,177	2,198
	Imports	...	132	212	154	...
	Total	1,958	2,546	2,700	2,331	...
Gram	Production	3,138	3,599	4,310	4,580	3,909
Sugarcane	Production	4,548	4,913	5,803	4,993	4,904
* Total for all food-grains	Production	42,361	43,446	49,649	49,253	50,745
	Imports	850	2,250	2,330	2,840	...
	Total	43,211	45,696	51,979	52,093	...

* Including semolina, millets, milo and oats.

(The above figures are taken from Records and Statistics published by the Eastern Economist, October 1950.)

The total of production and imports may be taken as th country's requirements in each year. The figures in Table constitute the so-called 'Time Series' and statistical methods ar available for determining the long-term movement or trend, cyclica and seasonal fluctuations and random variations, if any. Fron the point of view of planning it is important to obtain as accurat a forecast as possible of production and consumption in the nex few years. The trend curve may be used for forecasting, method which enables us to determine also the probable limit of error. There is also obviously a correlation between fooc consumption and growth of population and this relation may b accurately determined and used for estimating future food require ments. Only experience can decide as to which method woulc give the best results, but in any case some form of statistica analysis must be employed if any degree of reliability is to b attached to the results.

Self-sufficiency

There can be no two opinions about the desirability of ou country becoming self-sufficient in the matter of food. One o the major considerations is that food imports, being mainly from hard currency areas, impose a heavy strain on the exchequer During the four years from 1946–47 to 1949–50 the food subsidie were 5.4, 10.9, 9.4 and 10.2 per cent respectively of the tota expenditure in each year.

Here again a realistic approach to the problem can only b made through the medium of statistics. On the basis of th anticipated requirements the extra production necessary to achiev self-sufficiency can be estimated, and it is on the basis of thes figures that we can assess the possibility of attaining our idea and take suitable action in the matter.

One fact which clearly emerges from a study of the figure in Table I is that although production has steadily increased the increase has hardly been adequate to keep pace with th country's growing requirements, and this is also reflected in th remarkable rate of increase in imports until the year 1948. A rough estimate indicates that the present production of foodgrain

should be stepped up by at least 6 per cent if we are to arrive anywhere near the goal of self sufficiency.

This extra production can be achieved in three ways: (1) by increasing the area under cultivation; (2) by using improved methods of Agriculture and (3) by manufacturing synthetic foodgrains on a sufficiently large scale.

With regard to the manufacture of synthetic foodgrains, the scientists of the Central Food Technological Research Institute have been engaged in research of far-reaching importance. As in other manufacturing processes when large-scale production is undertaken, such as the production of synthetic rice from tapioca, the techniques of *quality control* may be usefully employed. Experiments on nutrition are also being undertaken. In order to obtain reliable information these should be designed and the results interpreted in accordance with sound statistical principles.

Increasing Production by Extending the Area under Cultivation

The following figures in Table II give the acreage under cultivation and the average yield per acre in the case of rice, wheat and the total for all foodgrains during the years 1945–46 to 1949–50.

TABLE II

Area under cultivation and the average yield per acre for rice wheat and all foodgrains together.

(Acreage in thousand acres—yield per acre in pounds)

		1945–46	1946–47	1947–48	1948–49	1949–50
Rice	Acreage	58,112	60,989	60,818	70,275	71,660
	Yield per acre (lb.)	712	729	719	692	685
Wheat	Acreage	24,496	24,350	20,209	21,855	23,627
	Yield per acre (lb.)	541	437	597	561	579
Total for all foodgrains	Acreage	181,615	185,268	181,779	193,389	199,148
	Yield per acre (lb.)	523	525	612	571	571

A significant fact revealed by the above figures is that in the case of rice, increase in acreage gives a reduced yield per acre, which is an indication that the process is an uneconomical one. Also other considerations such as irrigational facilities and climatic conditions obviously impose limits to the extent to which new land could be brought under cultivation.

Increasing Production by Improved Methods of Agriculture

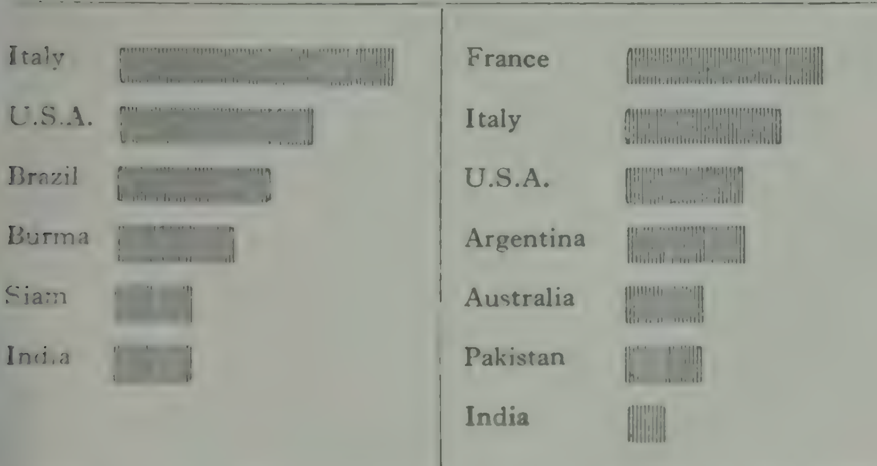
A preliminary examination of this aspect of the problem may be made by considering the yield per acre of foodgrains in different countries. The following figures are taken from an F.A.O. bulletin.

TABLE III

Average yield of rice and wheat in different Countries
(Metric tons per hectare)

Rice			*Wheat*		
	1948	*1949*		*1948*	*1949*
Italy ...	... 4.33	4.48	France	... 1.80	1.91
U.S.A.	... 2.41	2.47	Italy ...	... 1.32	1.47
Brazil ...	... 1.53	1.61	Australia	... 1.02	1.16
Burma ...	... 1.36	1.25	U.S.A.	... 1.21	1.00
Siam ...	... 1.28	...	Argentina	... 1.06	1.02
India ...	... 1.18	1.17	Pakistan	... 0.85	0.95
			India ...	... 0.66	0.65

(Diagrammatic representation of yields in different countries in 1948)



The above diagram brings out clearly the differences in yields. The figures for India are very low as compared with other countries, and there is no doubt that this is at least partly

due to differences in methods of cultivation. In this connectio it is interesting to note that although the area under cultivatio in the U.S.A. is only one-sixth larger than in India, yet tha country uses over sixty times as much fertilizer—more tha 13,000,000 tons a year compared with only 200,000 in India. Als the U.S.A. has nearly 2½ million tractors, India only 10,000.[4]

There appears to be considerable scope therefore for increasin the yield in the existing areas of cultivation by improved method of agriculture, including better treatment of the soil and usin better qualities of seed. But before new methods are introduce on a large scale their efficacy should be tested by experimentation and in order to get the best results with an economical expenditur of money, statistical principles and techniques associated wit agricultural experimentation must be exploited to the full.

The peculiarity of agricultural experimentation lies in the fac that the fertility of the soil varies from point to point in a complicated manner. Besides variations in climate and season produce different results. However, by suitably designing the experiment and applying the appropriate statistical analysis, it is possible from the results of a single experiment to estimate with accuracy the differential effects, if any, of different treatments of soil or of using different qualities of seed. The 'Randomised Block' and the 'Latin Square' are two widely used arrangements whereby variations in soil fertility are neutralised in the analysis.

Agricultural experiments may be conducted on the large scale, involving plots of an acre or more in size, and using ploughs, seed drills etc., or on the small scale in a garden. The former has the advantage that the ryot may pay some attention to the results as the experiment will be conducted in his fields. Also varieties that do well on the small scale may not do so well in the open field.

As an example of the large scale experiment I may mention one carried out in Ireland on several varieties of barley. It lasted for six years and seven varieties were tested on 193 plots of 2 acres each, scattered up and down the barley growing districts of that country. As a result of the experiment new varieties of barley were introduced which gave an average yield of 15–20

per cent above those which they replaced. The gain to the country was estimated at £250,000 per year while the cost of the experiment was £40,000.[7] The possibility of obtaining increased yields by replacing our native cereals with imported varieties is worth investigating.

NUTRITION

I wish to make a few observations on the important and useful part statistical techniques can play in the study of problems on nutrition.

From the point of view of nutrition, the foods which we eat must be regarded as mixtures in varying proportions of carbohydrates, fats, proteins, mineral substances, vitamins and other accessory substances. Each of these nutrients has some definite function to perform in the body, and in order to maintain good health, it is necessary that they are provided in right proportions in a person's daily diet. The amounts required vary for different individuals in different circumstances. The Committee on Foods and Nutrition, National Research Council, U.S.A., has recommended the following as the average daily requirements of differnt individuals.

	Calories	*Protien*	*Calcium*	*Iron*	*Vitamin A*	*Vitamin B_1*	*Vitamin C*	*Riboflavin*	*Nicotinic Acid*
		g.	*g.*	*mg.*	*I.U.*	*mg.*	*mg.*	*mg.*	*mg.*
Man (70Kg.) (*Sedentary*)	2,500 ...	70 ...	0·6–0·8	8–12	3,500–5,000	0·8–1·2–	52–75	1·1–1·6	8–12 ...
Man (70 Kg.) (*Moderately active*)	3,000	,,	,,	,,	,,	1·1–1·5	,,	1·4–2·0	11–15
Man (70 Kg.) (*Very active*)	4,500	,,	,,	,,	,,	1·4–2·0	,,	1·8–2·6	14–20

It is unnecessary to mention here the corresponding figures for women and children at various stages of growth, but I venture to suggest that it would be of enormous benefit if such data on nutrition were published and as widely circulated as possible.

Once the composition of various foodstuffs has been determined, then it is a matter of simple arithmetic to calculate whether a person's diet is adequate. But the composition of food of any kind varies considerably. For example, the milk provided in hotels may not be of the same nutritive value as that obtained fresh from the cow. This important problem of determining the nutritive value of foods can be tackled successfully by employing sampling techniques characteristic of statistical methods. By analysing random samples from a large supply it is possible to estimate the average amounts of the various nutrients in the commodity as a whole.

Nutritional Standards of our Diets

It can hardly be disputed that the average physical standards of our people are very low as compared with those in many other countries. Also persons in high places have made statements in public to the effect that Indians as a race are not hard-working. This may be due partly to climate, but I feel that it is also largely a matter of nutrition. For example, if a person's daily diet does not provide the requisite number of calories, he can hardly be expected to put forth the same effort as another similarly occupied who has an adequate diet. Much useful information could be obtained by selecting samples of the population and analysing the diets of individuals in various homogeneous groups, say, clerks, labourers, students, teachers, etc. This can most easily be done by ascertaining the total weights of various foodstuffs bought in their homes and the number of meals consumed. Where diets are found to be inadequate it may be possible by large-scale action to set right the deficiencies. For example in England in 1942, when many British diets were found short in Calcium, chalk (*i.e.*, calcium carbonate) was added to the National Flour so as to raise the calcium content of bread from 4 mg. to 16 mg.

per oz.[4] Also, according to a report of the Economics and Statistics Department of Lever Brothers and Unilever, Ltd., many Governments, by careful collection of statistics, watch the level of per capita consumption of oils and fats and take active measures if it is in danger of falling too low.[5]

In cases where a single meal is provided for a large number of people, say, by a canteen in a factory or school, it would be very advantageous if the meal is so devised as to make good any nutritional deficiencies in the other meals of the individuals concerned. This may be done by taking a random sample of those partaking of the canteen meal and ascertaining the types and quantities of food that go to make up their home meals. In this way the Oslo meal was devised for school children to supply those protective factors in which the remainder of the diet of a poor child was most likely to be deficient.[2]

Food Canning

The food canning industry is comparatively young in our country. Many of the processes, I believe, are jealously guarded as trade secrets in the West, and even our trainees who work in English or American factories are not able to discover them. Hence, much information will have to be gained by experimentation and it is here that statistical techniques can play an important role. For example simple tests may be used to study the effects of surface treatments and abrasion on the corrosion rate of tin-plate. Also, the formation of 'hydrogen-swells' during the storage of canned fruit is influenced by the presence of sulphur, phosphorous and copper in tin-plate, and the inter-relation of the many factors may be examined by correlation and regression methods.[6]

Animal Nutrition

Problems of animal nutrition are complicated by great variation found in the constitution of feeding-stuffs, in the ability of individual animals to utilize their food and the requirements of individuals for different nutrients. By careful planning, small treatment effects may be measured with precision. For instance,

animal variation may be controlled by selecting homogeneous groups, or a factorial design would permit the estimation of components of variation from different sources. Change-over designs, in which each animal receives each diet for some period of the experiment, are useful in measuring small effects.[6]

I hope this brief survey will have served to illustrate the importance and usefulness of statistics and statistical techniques in the study of food problems.

In conclusion, I wish to thank the organizers for their kind invitation to participate in this Symposium.

REFERENCES

[1] Some Aspects of the Statistics Programme in the Department of Agriculture, (U.S.A.), by Conrad Taeuber. (Jour. Amer. Stat. Assoc. March 1947, Vol. 42, No. 237).

[2] Manual of Nutrition, 1947. Ministry of Food, London.

[3] Co-ordination of Agricultural Statistics in India. Government of India, Ministry of Agriculture, September 1949.

[4] Records and Statistics of the Eastern Economist. October 1950.

[5] Sources and Nature of Statistical Information in Special Fields of Statistics—Oils and Fats Statistics. (Jour. Roy. Stat. Soc., Vol. CXIII, Pt. III, 1950).

[6] Application of Statistical Methods to Food Problems, by D. J. Finney. (Nature, Vol. 159 (4027), January 1947)

[7] On Testing Varieties of Cereals, by Student. (Collected Papers).

GROW MORE FOOD

by

Sir Datar Singh

(Additional Secretary, Ministry of Food and Agriculture [Agri.], New Delhi)

The paper deals briefly with the important role that the All-India Women's Food Council is playing to help in the production, utilization and consumption of supplementary foods such as sweet potatoes, tapioca, vegetables, fruits, etc. It is suggested that both the Government and the public should co-operate in this work which will go a long way in alleviating the food shortage in the country. Menus prepared out of non-rationed articles should be popularized by opening canteens. Exhibitions to demonstrate the utility of supplementary food should also be arranged. The Women's Food Organization should have branches in all parts of the country. The paper deals briefly with the aims and objects of the Women's Food Council. It also emphasizes that even children and University students can play their roles in the Grow More Food Campaign.

THE problem of the day is how to win freedom from foreign bread. This can be achieved only if the concerted effort of the nation is directed to the solution of the problem. In this sphere, the women of India can play a very important role. The Government of India have recently constituted the All-India Women's Food Council to help in the production, utilization and consumption of supplementary foods. Supplementary foods like sweet potatoes, tapioca, vegetables, fruits, etc., play a prominent part in the diet of the urban population of this country. In cities and towns, there is also a ready market for such foods. The incentive for increased production should, no doubt, emerge from Government, but the degree of success would depend upon the willing co-operation from the public. Every individual has an essential part to play, irrespective of the size of his holdings

or his capacity, knowledge and opportunity for work. Vegetables like tomato, gourds, lettuce, etc., can even be grown in wooden boxes, empty kerosene-oil tins and pots, etc. Nourishing menus can be prepared from supplementary foods alone. The consumption of these foods can be popularized by the opening of canteens where tea, etc., and standing lunches consisting of only supplementary foods may be served. Exhibitions should also be held to demonstrate the preparation of equally tasteful dishes from these foods. In order to take up all these items of work, it is necessary that Women's Organizations should be formed in every town and city of the country and, in any case, in the capital cities of each State to begin with. These organizations should be affiliated to the All-India Women's Food Council which consists of public workers and which is sponsored by the Government who will render every type of assistance possible. The aims and objects of the Women's Organizations should be:

(*a*) to hold meetings where they should do propaganda for saving rationed food and explain the Government's policy of saving cereals;

(*b*) to popularize non-cereal food;

(*c*) to preach observance of a non-cereal dietary once in a week, preferably Monday;

(*d*) to encourage kitchen gardens;

(*e*) to distribute baskets and boxes for growing vegetables to those families who have no compound of their own and also the necessary information about growing vegetables in baskets;

(*f*) to hold supplementary food exhibitions;

(*g*) to run cafetarias, if possible, where cheap and nutritive food is made available and work in such cafetarias as volunteers;

(*h*) to ask those who take part in this programme to try and save food in their own homes as well as grow vegetables in kitchen gardens or baskets to set an example;

(*i*) to meet every month for discussing the food problems and improving the methods of cooking and devising ways and means for constituting a balanced diet which can be prepared economically;

(*j*) that they also should take a pledge (*i*) not to buy black-market food; (*ii*) not to cash cards if they have surplus food at home; and (*iii*) take only 6 days account and such merit cards should be diverted to deficit areas.

> *N.B.*—If women knew that the food saved by them is going to be given to the people who are hungry in deficit areas or those who are in need, it will give a better impetus to them for saving food.

(*k*) to conduct classes for preparing non-cereal food.

(*l*) to undertake any other activity conducive to the furtherance of these objects.

The children of the country can also play their proper ole in these activities. In the pre-University stage, they can assist heir mothers and sisters in the functions mentioned above. University students can utilize their spare time in Grow More Food Campaign within the University area itself. They can lso play a large part by devoting themselves to G.M.F. work in he rural areas during their vacation periods.

EDUCATION AND FARM MECHANIZATION

Training is Essential for the Economic Use of Power on the Land

by

A. B. Lees

(*Harry Ferguson, Ltd., Coventry*)

The advantages of mechanized farming for increased food production are discussed. But without adequately trained personnel to man the farm machinery, mechanized farming may have adverse effects. It is therefore important to train the personnel so that increased production of food through mechanization could be achieved.

Increased productivity and greater efficiency is the plea put fo ward in nearly all quarters as the solution of most of the econom ills of the present day world. Both are abstract and in themselv intangible. Increased productivity can only be seen in the forr of goods, which result from the production and processing c raw materials by men and machines. Mechanization is at preser the most potent means of increasing output of raw materials an goods, but man is the controller of machines. Therefore, educa tion in the management of machinery is an essential corollar of mechanization.

On the land, the need for educated and skilled operators c tractors and implements is perhaps greater than in other sphere of activity because the soil and its products cannot, in the natur of things, ever have the same uniformity as the products of factory. Not only do soils vary in composition, but their physica characteristics change from day to day due to the largely uncon trolled influence of the weather and as a result of soil husbandry Similarly, the density, height, weight and toughness of any cro can only be partially controlled. A different machine canno economically be developed for each set of fresh conditions, nc indeed for, say, the scores of types of cereals whose behaviou will vary according to climatic conditions. Intelligent use an adjustment of machinery is the base on which farm mechanizatio is founded. Apart from skilled operation of machines, th

economic deployment of power well repays careful and continuous study. The man on the land has the further, perhaps unique, responsibility of conserving his raw materials by building up soil fertility.

If, therefore, the true reward of farm mechanization is to be reaped in the form of improved standards of living, specialized education of those engaged in it is a prime essential. It is regrettable that for some considerable time following the initial introduction of mechanisation the importance of education was scarcely recognized. Now, however, it is widely realized even in the short term outlook that skilled management, operation, maintenance and service are indispensable. The long term view envisages mechanization extending food production to previously neglected areas and as the forerunner of new methods to counter the ancient threat of soil erosion.

To provide and sponsor education has always been as vital a part of agricultural mechanization as the tractor itself. The aim should be to provide everywhere adequate facilities for training specialists in the use, servicing and maintenance of tractors and implements so that they in turn may pass on to others the knowledge and experience that has been painstakingly gathered over the years.

Often the lowest standard of operation and services is found among enlightened people with whom mechanization has gradually developed. This, to some extent, is due to the fact that it has been a gradual evolution from hand work to animal power and on to mechanical power. There was no starting point, when basic principles were laid down for guidance. As a consequence, the operator is sometimes content with standards that have become outmoded. In a hungry world the potential benefits of mechanization are such that it is criminal if anything below the maximum is obtained. Every member of the community, not the least the food producer, is the loser. The ideal policy is that every new tractor be not merely delivered, but installed, and until the new owner is properly instructed he is not required to accept delivery.

Obviously, correct operation has an important effect on the life of any piece of mechanical equipment. It makes the difference

between good and bad quality work and that in turn has a great influence on the subsequent returns from any crop. It is, however, often overlooked, in ploughing for example, that higher operating costs are incurred with bad work than good work. The wrongly set coulter not only prohibits nicely turned furrows: it increases draught uselessly and increases fuel consumption unnecessarily. For every optimum setting on any machine there are hundreds of wrong settings.

To a man who has been ploughing all his life, the suggestion that he may be setting a coulter wrongly probably seems too elementary to call for instruction. Yet it is their simplicity which makes many common points overlooked. Instruction and demonstration are essential for due appreciation. Without such appreciation even air cleaners are untouched and the inlets fill with dust until the tractor fails through lack of air. For many hours previously, efficiency of performance will have been seriously reduced.

Wheel slip is another elementary example. It causes undue tyre wear and reduces output and wastes fuel. The operator who knows what he is about finds the engine speed at which, wheel adhesion is best. He will know how to improve weight transference by hitch adjustment or loading. He will also appreciate the effect of tyre pressures. By contrast, the man who 'merely drives' will usually try to counter wheel spin by increasing engine speed, not only causing tremendous tyre wear and wasting fuel, but often ending in bad conditions by allowing the tractor to dig itself in. The operator of such a bogged machine will come to a full realization of his errors only by having to get it under way with guidance from an experienced man. Thereafter he will know the benefits of the slow running engine.

So much for examples of maintenance, implement adjustment and tractor operation in the field. The number of such points that constitute 'know how' is legion. The practical result is that the trained operator does more and better work at less cost and with less wear and tear. To apply knowledge to an operation requires less time than trying to do it without knowledge.

When the equipment is running efficiently, time becomes avail-

able to study and further to improve the plan of operators. Unnecessarily complicated process can be simplified or perhaps a new machine can be introduced to consolidate savings that have been made at a previous stage of operations. For example, where cereals are going for stock feed, costs can often be cut by eliminating threshing and putting the sheaves through a hammer mill. Or again, the tractor may be used in off-seasons for improvized civil engineering on the farm to alter layout of roads or boundaries to save much unnecessary travel.

No doubt exists as to the benefits of farm mechanization. In fact, the economy is so self-evident that the true object—cost reduction—is overlooked and efficiency of operation is allowed to continue at a level below that which is easily obtainable with trained operators. The way to increased efficiency and consequent increased production of food and industrial crops is by education and by insistence on personnel training.

FOOD PRODUCTION IN MYSORE

by

Sri M. K. Appajappa

(Commissioner for Food Production, Mysore)

The average production of foodgrains in Mysore is about 9 lakh tons while the requirements are about 11.41 lakh tons calculated on the basis of the present population. With a view to minimizing this deficit and stepping up production, a plan involving an estimated cost of 3½ crores of rupees was launched in 1949. This plan consists of construction of and repairs to irrigation wells, construction of major irrigation tanks, restoration of major tanks, lift irrigation and river valleys, improvement of river, tanks, feeder channels and other land improvement schemes. These projects, when completd, will provide additional irrigation facilities for an area of 2,58,281 acres from which 52,000 tons of foodgrains can be produced. The paper describes the efforts made in connection with the supply of improved seeds, manures, implements and agricultural machinery, and technical and financial assistance with a view to increasing the yield per acre.

In very few countries of the world is agriculture of such paramount importance as it is in India. It is the largest single industry providing occupation as well as means of livelihood directly or indirectly for about 75 per cent of the Indian population. Though it occupies a position of such paramount importance in Indian economy, the industry is suffering from various handicaps. In the first place, the pressure of population on the land is so very high that the net area sown works out to only 0.69 acres per capita calculated on the basis of 1949 population. Secondly, the holdings are diminutive and fragmented, while the yield per acre is very low compared with those in other countries. The essentials of agriculture such as improved seeds, manures, fertilizers, credit facilities, etc., are highly inadequate. Added to

this, illiteracy and indebtedness are prevalent on an appalling scale.

It is unfortunate that despite the preponderance of agriculture over any other occupation and the availability of vast resources, India should be in the grip of this food crisis which is threatening to disrupt its entire economy. Let us examine the causes which have driven the country into this state of affairs. Since the middle of the 18th Century we may notice that there has been a steady increase in the population. The production has fairly kept pace with the growth of population till about the year 1930 when it began to lag behind. The effects of the last war, and later the loss of some of the best producing areas as a result of partition, have mainly contributed to the shortage of food in the country. As a result, food worth millions of rupees had to be imported year after year, and elaborate arrangements made for its internal procurement and distribution. This has naturally resulted in a heavy drain on the financial resources of the country.

Imports of food grains are by no means a solution to the food problem of the country. They are a severe drain to the country's foreign exchange resources which must be conserved for purchase of capital goods and useful machinery. With the attainment of freedom the needs of nation-building programmes and the necessity to readjust the country's economy, make it hardly possible to spend large sums of money on such imports of food and its distribution to the people. In an agricultural country like ours where there is ample scope for stepping up of food production, the very idea of depending on foreign bread should be abhored to the core. It is therefore imperative that we should strain every nerve to make our country self sufficient in food as quickly as possible.

To solve this problem of food scarcity, Government of India have made plans for attainment of self sufficiency by March 1952. Mysore, being an integral part of the Indian Union and a deficit State with regard to food grains, has naturally fallen in line with the other States in implementing this policy of the Central Government. During normal times Mysore was self-sufficient in millets and deficit in rice to the extent of 60,000 tons. Owing to various

causes production of grains greatly declined since the year 1943. It was estimated that the population of the State would be 82.5 lakhs by 1951. But according to the recent Census the population of the State is to the order of roughly 90 lakhs. The total average production of food grains was calculated to be 9.00 lakhs tons while the requirements worked out to about 11.41 lakhs tons. The estimated deficit was therefore taken to be 2.41 lakhs tons. With a view to minimizing this deficit and stepping up food production, a Three-Year Food Production Plan involving an estimated cost of Rs 9½ crores was launched in the State during the year 1949.

The several schemes coming under this Plan are classified under four broad categories:

(*i*) Works Schemes,
(*ii*) Supply Schemes,
(*iii*) Service Schemes; and
(*iv*) Miscellaneous Schemes.

WORKS SCHEMES

The provision of irrigation facilities is of primary importance in any scheme for increasing agricultural production. Under the Grow More Food Campaign, both major and minor types of irrigation works have been undertaken. These include reclamation works, construction of wells, tanks, canals, reservoirs, the installation of lift irrigation pumping sets, etc., in respect of which considerable progress has already been made in the State.

1. *Construction and Repairs of Irrigation Wells*

In order to extend the area under irrigation with an assured supply of water, a scheme of providing subsidy to cultivators for sinking irrigation wells was undertaken and a sum not exceeding Rs 500 is paid as subsidy for each such well sunk under the scheme. One thousand and ninety-three irrigation wells have been sunk during the past two years in the State and the total area irrigated under these wells is about 2,200 acres.

2. *Construction of Major Irrigation Works*

This scheme comprises of the construction of new tanks, earthen dams across streamlets, putting up masonry anekats and

drawing channels therefrom, etc.; 18 such big works have been programmed under the plan, which are estimated to yield 6,636 tons of additional food grains. The total cost of this scheme is estimated at about Rs 20 lakhs. Three of these works have been completed and the remaining are in progress.

3. *Restoration of Major and Minor Tanks*

The Mysore State comprising an area of 29,500 square miles is strewn over a system of major and minor tanks to the extent of 26,000 in number, forming a net-work of almost one tank per square mile. These tanks are mainly intended for irrigation purposes. Most of them are highly silted up and require to be restored to their original standards if they are to function properly. Raising the bund and weir, breach filling work, repairs to sluices and removal of silt are some of the works urgently needed. In addition to employing manual labour for purposes of desilting the tanks, the traxcavators and the bulldozers of this Department are also being employed wherever it is found feasible, in order to achieve quicker results. Under this scheme, 249 tanks have been restored benefiting an area of 4,100 acres. The restoration of as many as 513 tanks is in various stages of progress.

4. *Lift Irrigation in River Valleys*

This scheme envisages the cultivation of suitable belts of dry lands on river banks and providing water to them by installing electrical lift irrigation pumps at Government cost. In the two schemes tried in the State, as an experimental measure, the results obtained are fairly encouraging. The operation of the scheme is being extended to other parts of the State. Further a new scheme of lift irrigation by which power lines are drawn to supply electricity to pump sets installed by the individual cultivators themselves, in the dry districts of the State, has been taken up during the year at a cost of Rs 50 lakhs. The work is under progress and it will be possible to supply power for 1,300 pump sets before the end of June 1951. There are already 2,385 electrical pump sets working all over the State.

5. *Improvement of River, Tanks and Feeder Channels*

Mysore State has a net-work of river channels serving more than one lakh of acres. In order to assure water supply to the existing area, and the tail end lands in particular, large scale improvements of these channels were taken up under the Grow More Food drive during the last two years. Six hundred and ninety-six works have so far been completed and 150 are nearing completion.

6. *Land Improvement Schemes*

The scheme comprises mainly of works relating to reclamation of waste and marshy lands by proper drainage, construction of pick-ups, contour bunding for prevention of soil erosion and providing roads to facilitate agricultural traffic in marshy areas. Such works are mainly concentrated in the Visvesvaraya Canal Area, Sulekere Valley, the Vani Vilas Sagar Anekat, Marconhalli and Anjanapur Reservoir tracts in the State. So far, 123 such works have been completed and as many as 240 works are in several stages of execution.

In addition to the above, Bulldozers and Tractors are made available for reclamation of jungle-grown and weed-infested lands owned by private individuals. 16,474 acres of such lands have been reclaimed during the past two years.

The completion of these works schemes already under execution will, it is estimated, provide irrigational facilities for an additional area of 2,58,281 acres, and the additional food production is likely to be of the order of 52,000 tons. All these schemes are of a permanent nature assuring increased production every year.

Supply Schemes

The low yield per acre in respect of several food crops in the country points out the vast possibilities of stepping up food production through intensive cultivation of the existing areas. In pursuance of the Grow More Food Campaign, measures have been taken to increase the yield per acre through the supply of improved seeds, manures, implements and mechanical appliances.

1. *Seeds*

The work of multiplication of improved varieties of seeds has been taken up by the Agricultural Department while the distribution of the seeds is made in a systematic manner through the 828 Multi-purpose Co-operative Societies organized all over the State. A large number of improved varieties of seeds of different food grains, suited to each locality, have been evolved by the Department of Agriculture. Such seeds assure a good yield, resistance to drought and diseases and timely maturity. Basic Farms run under direct supervision of the Agricultural Depatment have been started where pure strains of paddy suitable to the locality are grown. These seeds are distributed to progressive farmers and multiplied on their lands under the supervision of the Departmental staff. Such seeds are again purchased by the Department at a premium rate and distributed to the ryots through the Multi-purpose Co-operative Societies. A total quantity of 3,637 tons of seed grains has so far been distributed to the agriculturists during the past two years.

2. *Manure*

Oil cake procured from the local mills and Ammonium Sulphate and Fertilizers allotted from the Central Pool are mixed in proper proportions and distributed to ryots at cost price through the Multi-purpose Co-operative Societies. With a view to increasing the fertility of the soil, the cultivation of green manure seed is also encouraged by making it available to the ryots at half the cost price. During the past two years 22,337 tons of groundnut oil cake and fertilizers have been distributed under the Grow More Food Campaign.

With a view to popularizing the use of fertilizers, manures of the value of Rs 25 per acre, up to a limit of Rs 100 in each case, are given to ryots as loan, this being recoverable in the shape of paddy at the end of the harvest. The scheme is having a good response from the ryots, and manures to the value of nearly Rs 9.5 lakhs have been distributed during last year.

3. *Compost*

Great stress has been laid in the preparation of compost both in the urban and rural areas. Statutory provisions have been

made to enforce all the municipalities for taking up preparation of compost as an obligatory duty. With the financial assistance given by the State to these municipalities and also village *panchayets,* a total quantity of 1.74 lakhs of tons of compost was prepared and distributed to ryots during these two years.

4. *Supply of Agricultural Implements*

Nearly Rs 25 lakhs worth of agricultural implements required by the ryots were procured and distributed through the Multi-purpose Co-operative Societies during the last two years. About 35,000 feet of galvanized iron pipes have also been procured and distributed so far, and these have served 800 irrigation pumping sets.

5. *Tractor Organization*

The Department owns 132 Tractors and 22 Bulldozers. Arrangements have been made to provide their services to ryots at concessional rates to enable them to bring fresh and fallow areas under cultivation of food crops. Since the inception of the Food Production Scheme 32,650 acres of land have been tractor-ploughed and bulldozed.

With a view to popularizing mechanized cultivation, the ryots have been encouraged to own tractors and these are supplied to them by the department on hire-purchase system at a reduced price. There has been very good response from the ryots and as many as 17 tractors have been purchased by them under the scheme within a short period of five months.

6. *Supply of Electrical and Diesel Oil Pump Sets on Hire-Purchase System*

In order to provide facilities to individual ryots who are not in a position to purchase irrigation pump sets on cash basis, arrangements have been made to provide both electrical as well as diesel oil pump sets and persian wheels on hire-purchase system. The response from the ryots in this direction has been very encouraging and as many as 140 electrical pump sets and 95 diesel oil sets have been issued during these two years. In order to encourage the cultivation of food crops, power supply

is extended to electrical pump sets at a nominal rate of six pies per unit.

SERVICE AND MISCELLANEOUS SCHEMES

7. *Protection of Crops against Pests, Diseases and Wild Animals*

In order to protect food crops from the various diseases and pests they are subject to, the Department of Agriculture is providing necessary free services, through its technical staff, besides supplying various chemicals required for the purpose. Further, with a view to preventing destruction of food crops by wild animals in the forest areas of the State, the rules relating to the issue of gun licenses are considerably liberalized and the ryots have been encouraged to maintain fire-arms for the protection of their crops. 4,151 gun licenses have been issued during these two years.

8. *Extension of Cultivation*

In order to promote the extension of cultivation, Government waste lands, fertile date groves and Amrit Mahal Kavals are thrown open for cultivation on a large scale, and the same are being granted liberally to the ryots for cultivation of food crops. A total extent of 38,316 acres of land has been granted during these two years.

With a view to checking the increasing extent of fallow lands in the State and bringing under cultivation the existing fallow lands, the Mysore Cultivation of Fallow Land Act of 1951 has recently received the assent of His Highness the Maharaja of Mysore.

9. *Financial Assistances*

In order to enable the ryots to carry on their agricultural operations, financial assistance by way of land improvement and *takavi* loans is being extended liberally. A sum of Rs 6.22 lakhs has been issued during these two years.

10. *Co-operative Farming*

With a view to consolidating small and uneconomical holdings, creating better farming facilities and encouraging community

methods of agriculture, a scheme of co-operative farming was intr duced in the State and fertile Amrit Mahal Kaval areas to the exte of 9,000 acres have been assigned to the several Co-operati Farming Societies. Liberal grants and loans from Governme are also provided to these Institutions for their development the initial stages. The progress achieved in this respect has bee encouraging.

11. *Cultivation of Subsidiary Food Crops*

With a view to minimizing the pressure on cereal food grain the Ryots and the Coffee Planters, particularly in the Malna Districts, are encouraged to grow subsidiary food crops lik Tapioca, Plantains, Sweet Potatoes, etc. Government have al financed under subsidiary food production, schemes such as i creasing the production of fruits and vegetables, starting of dairi and poultries in the Government Farms, development of fisher etc. The Women's Food Council started in Bangalore as a branc of the All-India Organization has been, among its several activitie devoting its energies towards propaganda regarding the cultivatio of vegetables in kitchen gardens and the use of Tapioca produc in order to minimize the consumption of cereals as far as possibl

Before concluding my remarks on the subject, let u recall the repeated appeals made by our Prime Minister India that the food crisis must be tackled on a war basis. A the present time when the country is facing a great nation emergency, it is fitting that all our countrymen should know th facts about our food situation. We are in the thick of the wa against lack of food. We have got to fight more fronts tha one in order to become self-sufficient and independent of impor from foreign countries. We should also not underestimate th consequences which may arise in case we fail in this battle. Th Government has laid down laws to enable people to meet th situation and has also made plans to supply the necessary materi and technical help. But all the plans made and the laws lai down will certainly not bring increased food production unle the public wholeheartedly co-operate in this period of nation emergency. The obstacles before us are many; but they are n

unsurmountable. The scope for progress is great provided all the sections of our people join with a dogged determination and fight the war on the production front. In this fight for economic freedom, there is not a person who ought not to be mobilized. The cultivator who occupies an important place must grow more food with a patriotic feeling.

As conservation of food is as important as growing it, it is the national duty of every citizen to strive his utmost in tightening up his belt, stop entertainments and avoid every kind of waste, both in the kitchen as well as on the table. Let us again remember the remarks of the Prime Minister that waste for the purpose of ostentation is not only the height of vulgarity but a crime. Another important front from which the battle against food scarcity has to be fought is the change to be effected in our age-long food habits, particularly in respect of rice. Realizing, as we do, the scarcity of cereals and the difficulties of securing them in sufficient quantities, it is high time we changed over the menu in our diet. The recent revelation regarding the rapid increase of population in the rice-eating areas and the gradual reduction in the production of that cereal in those areas, makes it all the more necessary to reduce the rice diet in our food habits, and increase the use of other substitutes. Subsidiary foods like sweet potatoes, tapioca, vegetables and greens which are equally nutritious have to be substituted, as far as possible, in our daily diet in order to reduce the pressure on cereals. Our hopes are largely centred around the activities of this Research Institute which, under the able guidance of Dr Subrahmanyan, is doing its best to evolve a synthetic cereal to take the place of rice in our daily meal.

Having done our part of the duty, let us invoke the blessings of God from the nature's front for better seasonal conditions for the achievement of our object in times to come.

SELF-HELP IN FOOD

by

Sir Sonti V. Ramamurty

(*Agri-Horticultural Society, Madras*)

The theory of Malthus, as expanded by the Agro-biologists, that the productivity of the earth sets a limit on population is only half true. Food may be produced not only through causation by the Earth but also through creation by man. Science and organization are the means through which the flux of creation in man's life may concretize itself. With creative activity man may help himself to growth without limit in quantity as well as in quality.

In dealing with the relation of food and population there ar three factors namely, man, food and the earth. The Malthusia theory made out that the earth's capacity for production of foo sets a limit to population. Food is the product both of man an of nature, because while the earth produces it, food is that whic is adapted to man. The earth, in virtue of its own nature produces various products some of which are good food for man some are poor food; some are no food. But whatever the eart produces, there is a maximum limit to its productivity in respons to the stimuli of various kinds. The science of agrobiology ha evolved a formula which relates cause to effect in the realm o earth's production. This formula is as follows:

$$a - y = ae^{-cx},$$

where the quantity a is the maximum of the effect y correspondin to the cause x. Given any particular cause, the earth sets limit to its effect.

Causation however is not the sole process in the developmen of reality. The other process is creation. Matter is the vehicl for causation; mind is the vehicle for creation. Both causatior and creation are fluxes of the basic single entity of the univers

which may be called spirit. It is therefore possible not only for the earth to cause food but also for man to create food. The development of resources is the result not of man plus nature but of man multiplied by nature. Food may be increased either through causation or through creation. The Malthusian law cognizes only the production of food through causation by the earth. Given the same natural resources and the same stimuli which produce food from the earth, it is possible to increase food through creation by man.

Science is dual in nature. It partakes of the realism of the earth and of the idealism of man. Science therefore can either enhance the results of causation or stimulate the results of creation. Agricultural research is intended to produce better results in the production of food by varying, to the utmost extent possible, the stimuli that cause food such as manure, water and so forth. But the intelligence of man, applied to the data of nature, can build on nature and transcend the maxima which nature without the help of man sets for itself. Man therefore may depend not only on the help given by the earth but also the help that he can give himself. When the earth gives good food, man has to take care that he does not make it poor food as he does when the vitamins and minerals are removed from the rice grains and he eats the debilitated polished rice. He can however assist the earth to grow more rice in order ultimately to help himself. But there are ways in which man can help himself by the direct creative activity of which he is the vehicle. Science enables him to concretize creation. He can make better seed. He can make new seed. Thereby he can increase the availability of good food. Again, he can take up poor food produced by the earth and, by synthesis and processing, make therefrom good food. The production of synthetic cereals is a case in point. Earth produces tapioca; it also produces groundnut. But each by itself is not good food for man. It is through the knowledge of the ingredients of food that man gains from science that he can put together different types of poor food and make the result, good food. He can go further and make non-food into food, because all things whether they are food or non-food are at bottom derived from

one basic entity. In the Middle Ages, alchemists tried to find one base for all elements and thereby transform one element into another. So also, if non-food is analysed and resynthesized after modification where necessary, good food for man can be produced This has already been achieved in the case of organic non-food For instance, saw dust has been converted into sugar in Germany The problem is different in degree but not in kind when inorganic material has to be converted into food for man. Some kinds of inorganic material such as iron, magnesium and calcium are already necessary ingredients of good food, but through the achievements mainly of chemistry, inorganic non-food may also be converted into the forms that sustain and develop man Besides research in science, there is also the need for the development of technology whereby the results of science are applied to the products of nature. Food research and food technology which are the bases of the activities of the Central Food Technological Research Institute are means whereby man can either enhance the causation of food by the earth or stimulate the creation of food by man.

I have given above the formula which the agrobiologists give for causation in agriculture. I believe that this formula applies to causation in general. It seems to me that creation is not an act but a process as orderly as causation. If I may suggest a formula for creation, it is this:

$$a + y = ae^{cx}$$

Creation follows the law of increasing returns while causation follows that of diminishing returns. Science with the materialistic atmosphere in which it has grown in Europe has confined itself largely to the production of food by causation through the earth but we know the story of Vashistha who from a little water was able to produce all the food that was required by a king and an army who visited him. We know also the story of Jesus who from bread crumbs was able to create the food that was required for the many that gathered. It seems to me that creation is as real as causation. The Indian sages developed science more as

creation through the vehicle of man's mind while western science has been developed in respect of causation through the vehicle of nature. If, therefore, we were to consider what are the limits to population through food, I should say that if man were a passive spectator to the process of nature, the productivity of the earth sets the limit to the population which the earth can sustain. Malthusians imagined that this limit was not far from the population that had already grown. The agrobiologists have a deeper insight into the productive capacity of the earth and have stated that the earth can maintain something like five times the present population without any nation having to feel the need to go to other countries as conquerors or, I would add, as coolies. But, if man were to get into his stride and begin to develop his creative capacity there is indeed no limit to population. Man's creative capacity could overflow beyond the earth into other planets, into other heavenly bodies, into the limits of space and perhaps even grip time and modify its direction. The ultimate target of man is, according to all religions, God. God is infinite not only in quality but also in quantity. Man can help himself through the qualities that God has implanted in him to develop into an infinity both of quality and of quantity. This is a very long-range view. But, I have mentioned this to indicate that the problem of food and population must be viewed not merely from the side of the earth but also from the side of man. I have mentioned that science and technology enable him to increase the productivity of the earth and its usefulness for man. But it is open to man himself to build a second dimension on the earth's line of development. We know how among the nations with the same natural resources, some do better, and some do worse. It is not difficult to imagine that if the resources of India are exploited by a race possessed of greater energy than Indians now, India can produce much more. From the point of view of physical causes and effects, there is no reason why India should not produce double or treble the quantity of cereals per acre it now produces, because other countries like China, Japan, America and Australia are able to produce much more than India now does or rather Indians now do. The element that

is weak in the economic development of India is not nature but man. Man is the weakest link in the production of food in India.

The increased production of food has received much attention during the last few years through the Grow More Food Campaign. It seems to me that the more important line of work which the Grow More Food Campaign is developing is not making better seed than we have, finding better manure than we know, following better methods of cultivation than we have followed but applying the energy of man to the known methods in order to produce better results. My experience in the Grow More Food campaign has shown me that there are two hurdles in adding to the production of food. At the level of the individual cultivator, the hurdle is poverty. It is not the lack of intelligence, not the lack of faith, but the lack ultimately of finance that prevents the small-scale cultivator of India from applying science to agriculture. To give him financial assistance and to spread the application of science, there is need for better organization at the top which means better vision, stronger faith and more energetic drive.

The food problem of India is increasingly one of self-help by Indians to evolve better methods of science, better processes of technology and to apply this knowldge with persistence and energy. This is the solution for the present lack of enough food in India.

If I may give concrete suggestions as to the way in which science and organization can be applied by man to improve the food supply particularly in South India, I would say, first, the application of chemical manure to areas of assured irrigation in order to increase the results of the effort that now makes rice, secondly, the utilization of tapioca and groundnut cake powder in order to synthesize them into food that is as good at least as rice, and thirdly, avoiding the wastage into the sea of the rain water from the west coast which flows all the way to the east but is 90 per cent unused. These three ways embody science and organization and if they could be adopted with vision, faith and vigour, the food deficit of South India is certain to be met.

INCREASED FOOD PRODUCTION FOR GROWING POPULATION

by

B. Viswa Nath

(*Regional Agricultural Production Commissioner, Delhi*)

In raising the standard of living in India, quantity is the first consideration, and then the quality. The statement in the press that the population in the Indian Union increased more in the rice-growing areas than in other areas, requires proper study. The average yield of wheat per acre in India during the past five years compares favourably with that of other agriculturally advanced countries. Particular attention is drawn to factors such as lack of drainage, delayed plantings and timely water supply to crops. It is recommended that proper incentives should be offered to Indian agriculturists and producers. When the irrigation projects now under way will be completed, it should be possible to equate population and production.

THE earlier papers have dealt with increase in population and with the 'Grow More Food' drive. The demographers, Dr S. Chandrasekhar and Dr C. Chandra Sekar, have stated that during the past three decades, our population has been steadily increasing and that unless there is a check in reproduction, it would be impossible to raise the standard of living, which is very low as compared with that in countries in Europe and America and some in the Far East. The Assistant Director-General of Health, Dr Mitra, stated that diet surveys in recent years have shown a diminishing intake in all kinds of foods.

It is a fact that agricultural production, particularly food production, has not kept pace with increase in population and its needs. I do, however, feel that having regard to the possibilities of science and the potentialities of our land, the gap can be bridged.

I would look at the problem from another angle. The very fact that population is increasing indicates that conditions are,

on the whole, favourable for life. The standards of living may not be as high as in other countries or are not what one would wish to have. The standard of living is a variable condition. Different countries have different basic standards and different auxiliary standards. In our own country different regions and different classes of people will need different living standards. But the first and the foremost standard of living, that has to be raised and that can be raised, is to get adequate food to meet the requirements of the population. I shall put quantity first, next I shall put quality as demanded by public health experts and medical authorities.

Before I pass on from this point of population, I would like to draw your attention to one statement that has recently appeared in the press drawing attention to the fact that, according to the latest census figures, population in the Indian Union has increased more in the rice-growing areas than in other areas. The following are the figures showing percentage increase during the past three decades:

	1941–51	*1931–41*	*1921–31*
Indian Union	13·4	13·4	14·3
Travancore-Cochin	23·6	18·9	26·3
Madras	14·3	11·6	10·0
U.P.	11·9	13·6	6·7
Bihar	12·3	12·3	11·6
Madhya Pradesh	8·6	10·3	13·7
Punjab	0·4	17·9	9·9

There are geographic variations, though not very consistent. To what extent this is due to socio-economic factors and/or to rice diet, needs enquiry. Travancore–Cochin State which is highly deficit in rice and produces and consumes tapioca and sweet potato in large quantities does not seem to square with the rice diet idea.

The system or custom of early marriages and joint family system and family labour among cultivating classes, which are still the dominating features of our agricultural system and

tradition, may be some of the causes. If further examination confirms the preliminary finding from the census data, the subject requires study. If rice diet has been responsible for increased fertility then I must congratulate Dr V. Subrahmanyan and his associates for the synthetic rice from tapioca starch and defatted groundnut cake. That will be rice without Vitamin E, the chief Vitamin responsible for fertility. If that is the case, one of the means of checking population would be to give up rice cultivation and substitute in its place wheat cultivation or any other cultivation. That may not be possible in all the rice areas, particularly the low lying areas.

Coming now to food production, the question is whether we can hope to produce enough food to improve the physical fitness of our agricultural and industrial workers and Defence Services. The answer is in an emphatic affirmative. As Sir Sonti V. Ramamurthy has said food is produced not only by the earth but also by man. It is the result, not of earth plus man but human element multiplied by the earth. The achievements of science which are the result of knowledge multiplied by the creative power of man are there. The production power of agriculture is great. Its realization is a matter of science and its suitable organization in tune with the changing politico-economic and socio-economic conditions in the country. The organization should not be rigid. The problem is essentially a human problem and naturally the organization has to be in tune with human aspirations.

India is in the tropics and sub-tropics where the sun shines most and vegetation thrives best. For several centuries in the past, Indian agricultural production helped in the advancement of many countries in the temperate regions. If today India is found to have allowed her population to outstrip her agricultural production, it is because of neglect, in the past, of agriculture and the agriculturist.

I shall illustrate what I mean by the production power of our agriculture by comparing the national averages of two of our major food crops—wheat and paddy.

National averages—Wheat

	lb./acre
India	633
U.S.S.R. ...	776
Canada	633
Australia ...	714

The comparison is with the most agriculturally advanced countries. We are not very far from these countries even now. This is the position when only twenty per cent of our wheat area is irrigated and the remaining eighty per cent has to depend on precarious and erratic rainfall. Production will increase as irrigation expands.

In regard to paddy the position is as follows:

National averages—Paddy

	lb./acre
Italy	4710
Spain	4675
Japan	3221
Egypt	3113
China (Proper) ...	2284
U.S.S.R. ...	1909
Siam	1365
Java	1208
Burma	1275
India	1195
Indo-China ...	909
Ceylon	802

These figures as well as those for wheat are 5 year averages (1934 to 1938) taken from F.A.O. Year Book 1947. Unlike wheat, paddy is a crop grown either with irrigation facilities, or under adequate rainfall. Therefore it is not altogether a matter of lack of irrigation facilities as in the case of wheat. The problem is deeper. It is not in all cases a matter of high averages

resulting from small acreages. Japan and China have an equal and larger acreage and produce about three times or more than India. One striking feature is that the yields fall from higher latitudes towards the equator. But this is only apparent. Even in the same latitude and round-about, the production in India is lower. The reasons for this may be (1) inadequate and untimely water supplies, (2) lack of drainage, (3) lack of manuring and (4) disastrous floods. The schemes and projects for the exploitation of the rivers in the different parts of the country, apart from irrigating new land, will permit the control and conservation of the waters of the rivers. This will control floods and consequent damage to growing crop, and to that extent will effectively aid the production power of our agriculture. There, however, still remains the necessity for investigating the causes of the low paddy yields in India.

Not only that, there has been a small but steady decline in production per acre. At best, it may be said that the yields per acre have been stationary. While in North India water supply in the rivers is more or less assured both in respect of time and quantity owing to the melting of the snows in the Himalayas, in South India the rivers have to depend on rains in the catchment areas and these rains cannot be depended upon with any degree of certainty in respect of quantity and timely availability. The conditions during the past two years are such as would only occur at long intervals. Monsoon rains failed to feed the rivers, tanks and wells in South India—thus affecting the sowing time and the growing of crops. In North India the melting snows augmented by the rains caused floods damaging the crops. It was an unusual combination of drought in one part of the country and deluge in another—a combination that occurs rarely or at long intervals. The irrigation projects that are either in execution or are under contemplation should be such as would take into consideration the adequate provision for the seasonal supply of water and for drainage—both surface and sub-surface. Most people are probably unaware that the yields of paddy in the deltaic or river systems are lower than the yields from those under tanks or wells. For instance the Tanjore delta in spite

of its net-work of irrigation canals occupies a place about 15th in rank among the districts in Madras State, in respect of yield per acre. Similar is the case in the Godaveri delta. A preliminary investigation has given indications that the low yields are chiefly due to lack of drainage and delayed planting on the one hand and inadequate supply of water at the end of the life of the paddy crop on the other. A fortnight's to a month's delay in seasonal planting can reduce yield of grain and straw by about 25–50 per cent. Manuring cannot offset the fall in yield owing to delayed planting. The length of a feeder canal and the flow of water of the canal are such that large sections of areas do not get timely supply in the season with the result that planting is delayed—sometimes by four or five weeks. When these old irrigation systems commenced decades ago, there was no knowledge of the necessity for drainage and for timely supply. The entire project was conceived and executed on the basis that all that was required was the delivery of water and for as much area as possible and with the least cost. Experience would now indicate that drainage and supply in time for the season, are essential for maximum production per acre. The new projects should take note of these experiences and make provision for drainage channels for sub-surface and surface drainage and also provide for large number of reservoirs to deliver water in every field by the middle of June at the latest.

I have already said that agriculture, apart from its dependence on water supply, seed, manure, and climate, is primarily a human problem. The human problem of the modern world is primarily one of psycho-economics. We have so far spent in the aggregate during the past few years vast sums of money in importing food grains. In one sense it may be looked upon as subsidizing agriculture elsewhere. Cannot that be done in our surplus production areas to provide incentive to the producer? Price is not all important. It is the cultivator's margin that is most important. The cultivator has to pay high prices for the materials he needs for his production as well as for his consumption. This is a problem that scientists and statesmen should consider and devise means which while keeping down

the price for the consumer, actuate the producer. Within the next ten years, it should be possible, with the completion of the irrigation schemes, to equate population and production. The bad weather conditions that we are experiencing now will not continue for ever. The worst seems to be over and it seems to me that we have either turned the corner or are about to turn the corner in regard to the present crisis.

SUBSIDIARY FOODS

by

A. K. Yegna Narayana Aiyar

(Formerly, Director of Agriculture, Mysore)

The many important national schemes undertaken to increase the production of staple foods in the country are admirably well-conceived and their speeding up is stressed. In regard to the manufacture of phosphatic manures, the production of elemental phosphorus and of double fertilizers like ammophos, is suggested in preference to superphosphate, in view of the shortage of sulphur and sulphuric acid. With regard to subsidiary foods, the need and scope for their production are dealt with with reference to (1) known tubers like tapioca, sweet potato, potato, arrowroot, yams, etc., (2) less known tubers like the dioscoreas and Coleus parviflorus, *(3) the little known fruit called 'Singara' nut, (4) seeds of* Amaranthus paniculatus, *(5) cooking plantains and papayas and (6) seeds of the jack fruit. The role of cereals other than rice, of pulses and of groundnuts as subsidiary foods to rice is explained in detail.*

A good demonstration drive to popularize the use of these subsidiary foods through the ordinary hotels and restaurants and special canteens is urged.

Fish is described as the most important among animal foods. A great intensification of effort in the development of inland fisheries and the utilization of marine fish is recommended, the present scale of operations being hopelessly inadequate. Dairy products, poultry, eggs, meat of many kinds are referred to and their greater production and extended use suggested. A form of mixed husbandry which will embrace the production of these foods and not merely confine itself to the raising of crops is recommended as desirable. The products of the chase are also referred to in supplementing normal foods.

A list of 'famine foods' which were resorted to as emergency foods during previous famines is appended and further work on these foods is suggested.

THE acute shortage of food grains which this country has been experiencing for the last seven years and the remedial measures taken by the Government are extraordinary in many respects. India has had many famines in the past, some of them unsurpassed in their vastness and severity, but none has lasted so many years nor prevailed so universally through the length and breadth of the land. Moreover, the shortage continues in spite of the stupendous annual imports of all kinds of grains from every possible country in the world, and of the strenuous attempts at increasing home production. As regards remedial measures, while in the past, Government has tried to fight famines by the opening of famine camps and carrying relief only to the needy and the destitute, in the present case Government has taken upon itself the duty of feeding everyone, a truly superhuman task. This measure of giving each one his daily bread across a ration shop counter has landed Government in an impossible situation, the task being found more and more difficult on the one hand and the system itself once-initiated impossible to abandon without risk of serious consequences, on the other. The only way out of this baffling dilemma is increased production. The vast schemes of land reclamation and settlement, the numerous irrigation projects, the fertilizer factories and other schemes which are all under way are admirably well-conceived and have only to be speeded up. In regard to phosphatic fertilizers, however, I may point out that in view of the scarcity of Sulphur and Sulphuric acid the manufacture of superphosphate should no longer be attempted but that the isolation of elemental phosphorus and the manufacture of ammonium phosphate should be taken up instead.

The role of subsidiary foods in this gigantic set up can but be small, but a knowledge of what they are and how they can be used will help the public to eke out their meagre ration; may relieve the pressure on the demand for cereals to some extent and may even stimulate research leading to a permanent increase in our food resources. At any rate, every little attempt helps in these difficult times and this will justify attention being bestowed on them.

What are these so-called subsidiary foods? They are, as the name implies, distinguished from the *staple* foods, and comprise those which can supplement or even partially substitute the staple foods. They are generally less difficult of cultivation and imply a somewhat unused abundance being consumed only to a smaller extent. Although it is chiefly as suppliers of—starch, energy or heat producing components of foods and especially as a supplement to or substitute for rice that they have been familiarized, they may include complete foods as well and also those that make up deficiencies of particular components. I shall deal with all of them briefly.

Among such starch supplying subsidiary foods the most notable are the many edible roots or tubers, *i.e.,* the underground swollen stems and roots in which some plants store up starch. Examples are potatoes, sweet potatoes, tapioca and many others to which reference is made elsewhere in this paper.

The tapioca is by far the richest among them, with a starch content of about 38 per cent. Having been introduced over a century ago into Travancore by one of its far-seeing Maharajas, it is there that the crop is grown extensively at present. It is a 10–12 month crop, and yields abundantly, requiring a high rainfall or moderate irrigation. The roots contain a certain amount of the poison, prussic acid, and can be eaten only after being boiled. It can be eaten like a boiled vegetable, or dried and ground and made into a flour or meal. In either form it can very materially supplement rice. The flour however has industrial uses and as sizing material is in great demand in the textile mills (which are formidable competitors with it as a food). This is similar to using casein for plywood glue and for umbrella handles while the need for food is so great in the country. It is a question whether such use or misuse of food should not be forbidden.

The sweet potato comes next with a 31 per cent starch content; its use is safe and well known. It is a much satisfying food and is often the poor man's standby during famines. Its cultivation and use deserve to be increased.

The potato is really the king of tuber crops; it gives a crop in 90 days, two crops can be grown in the year, with a third

crop of short season *ragi* or maize in addition under intensive cultivation. Though grown only on the hills and plateaux, it can be grown on the plains also in the cold weather. Its starch content is about 25 per cent but a single crop may yield up to five tons of the tuber.

The yams like the elephant yam, 'Surangadde' (*Amorphophallus companulatus*) and the colocasias like *C. antiquorum* (Samegadde) are well-known edible roots which yield abundantly and are in general use.

The roots of the *Dioscoreas* attain remarkable sizes, of even 25 lb. and in one species viz., D. *alata* is said to have reached 85 lb. It may not be generally known that attempts were made some fifty years ago to popularize West Indian varieties in India by one Mr Mitchell in Calcutta. Though this has not caught on, many local varieties are already under cultivation and are common vegetables; these are the species *alata*, *globosa*, *purpurea*, and *sativa*.

Coleus parviflorus yields an excellent tuber in abundance and deserves to be cultivated largely.

The fruit called *Singara nut* (*Trapa bispinosa*) is a great standby in Kashmir, Bengal and Bihar. It is an aquatic plant and many tanks and lakes can be used for growing it; it does not therefore compete for land with other crops. In Kashmir it is reported to furnish food for five months in the year to 30,000 people and that one lake alone, the Wulur lake, yields 100,000 ass-loads of the nut per year. It is a six months' crop with a starch content of 25 per cent, and is eaten boiled, popped, or roasted and ground. It is eminently worthy of introduction in other parts of the country as well.

The arrow-root which grows both wild and in a cultivated state to some extent, both in the West coast and in the Orissa State, yields an excellent and well-known flour, estimated at about 13 per cent on the weight of the fresh-roots, while the edible cannas more or less come in the same class.

The seed of the jack fruit comes in a separate class; it is almost a by-product, but has nearly 40 per cent starch. It can keep, and so can be had both in the jack season and out of it. It can be eaten toasted, boiled or made into flour.

The cooking plantains and dessert plantains are other good sources of starchy (or sugar) foods, and are too well-known to be described.

The papaya friut holds great possibilities. It yields abundantly. The green fruit can be used as a vegetable while the ripe fruit is as satisfying as a meal. In one's and two's every household can grow it and make a substantial addition to its food supply.

The seeds of the Amaranthus paniculatus (Kannada—Rajakere or Horigire) afford a rich source of starch and are eaten fried or popped. One story goes that it was the means of saving many lives in one of the famines in Mysore. It grows wild and is also cultivated to a small extent, but deserves to be extended.

Buckwheat (which is not a cereal) is another crop worthy of larger cultivation. It is a ninety-day crop, can thrive on rough poor soils and at present has some vogue in Northern India. The flour is a highly esteemed food, considered more nourishing than many cereals, and may amount to half the weight of the seed. The seed has however to be broken and the seed coat removed to get at the flour.

The next group comprises *the grains and pulses*, which can in one sense be called 'subsidiary' also, and constitute far and away the most important group. Where rice or ragi is the staple food, for example, wheat and the other grains become subsidiary and *vice versa*. It is possible that a diet of more than one cereal is better than that confined to a single cereal, and these subsidiary foods may therefore be found to play a very important role. The pulses have the distinguishing merit of being proteid foods besides containing large quantities of starch, so that they furnish both the components. They may be available in plenty when rice may not be, and hence they may be used to make up the deficiency. The vogue of eating fried and salted pulses, including groundnuts, as a snack is to be welcomed. Groundnuts are indeed weight for weight about 50 per cent more energy-supplying than rice.

All the foods listed so far can be prepared into a number of dishes and this opens out a wide field for the exercise of the culinary talent of our women-folk, some of whom are wizards in

the art and can work wonders with them. I can personally testify to the excellence of many dishes prepared out of the so-called inferior grains like *ragi, bajra, jola,* etc. What is wanted is a big demonstration drive, in which all the hotels and restaurants should actively co-operate.

I must however deprecate the processing or camouflaging of the staple foods, into the so-called synthetic grains, patent foods, alimentary pastes and powders and so on. It will be easy enough to prepare balanced and fortified mixtures, of this kind, but in doing so the grains lose their identity and this will straightaway open the door to all kinds of adulteration in unscrupulous hands, besides withdrawing good and much sought-after food from the direct consumption market and processing them into forms of doubtful merit which will in any case need much popularization. It is a great safety that in our country rice and other grains are bought and sold as such and not as flour or bread.

A more fruitful field for research and a less objectionable one, if one may say so, will be in discovering new sources of food products. Many a vegetable product such as root, leaf, flower and fruit now available in abundance though rich in food, cannot be used as such on account of their association with unpalatable, or deleterious compounds, which if discovered and removed, will render the parent article fit for human consumption.

The so-called '*famine foods*' come under another class; they are eaten only when sheer hunger drives people to do so. Many years ago a collection of fifty odd articles of this kind, was sent up for analysis, to the Mysore Department of Agriculture and some work was done on them, though it was not pursued—I append a list of these, together with their analysis; I mention this only to show that research may be able to render many of them more suitable as food.

I now come to the next group, viz., *animal food*. The most important among them is fish. With its enormous sea-board and freshwater lakes and rivers, India's resources in fish are almost inexhaustible. The Royal Commission on Indian Agriculture stressed the importance of fish food in a country where rice is the staple food and strongly recommended its development. Fish

is indeed the food which has helped Japan to maintain a dense population on the minimum of rice land. Besides feeding her own population, Japan exported annually marine products including agar-agar, to the value of 300,000,000 yen. In India little has been achieved, despite the great need and scope. A vast permanent source of food thus remains untapped.

The next is poultry, eggs and, I may add, pigs. These are means of converting the by-products and waste materials of the farm and the home into valuable human food, and deserve utilization to the full. War time food production in Great Britain centred much round these products and the methods are worth copying. It is peculiar that in India agriculture is associated in the public mind with crop production alone, whereas, a farmer raises not only crops but produces milk, poultry and eggs, rears a few sheep, fattens a pig or two and, if conditions permit, goes out after game; the products of the chase in India are by no means insignificant and deserve greater attention. To this long list, miscellaneous food products like dried yeast from molasses, mushrooms both wild and cultivated, sea-weeds and so on, may be added, all of which can be profitably developed.

We have practically unlimited resources in food, but they need developing; and so far as these subsidiary foods are concerned, what is required is a good deal of propaganda on the part of the Government, a spirit of responsive co-operation on the part of the public as a line of immediate action and scientific research as a long range and continuous activity even after the present crisis is past.

APPENDIX

(Taken from the Eighth Annual Report of the Agricultural Chemist for the year 1906–1907)

TABLE I

LIST OF "FAMINE FOODS."

No. 1	Local Name 2	English Name 3	Botanical Name 4	District from which sent 5	Remarks by the Sender 6
134	Gutti gadde ...	...	...	Kolar	The tubers are boiled with *dhal* and eaten mixed with salt. Delicate persons are said to develop rheumatism if they eat this food.
135	Bendli soppu ...	Bastard sandal	*Erythroxylon monogynum*	,,	The leaves are dried and boiled in water with salt.
136	Devadari or gyadari soppu ...	Commonly known as the beal tree	*Aegle marmelos*	,,	The leaves are dried, ground, mixed with *ragi* flour and cooked.
137	Nauare genasu ...	...	...	Mysore	Eaten fried or boiled, said to produce cough.
138	Sal Genasu ...	...	...	,,	...
139	Karane genasu ...	...	...	,,	...
140	Kall genasu ...	...	...	,,	...
141	Akki genasu ...	...	...	,,	...
142	Adavi genasu ...	Species of yams	*Dioscorea*	Bangalore	...
143	Nose gadde ...	...	...	Kolar	The tuber is ground, mixed with tamarind and made into cakes.

TABLE I (Continued)

No. 1	Local Name 2	English Name 3	Botanical Name 4	District from which sent 5	Remarks by the Sender 6
144	Kathale gadde ...	Aloe roots	*Agave Americana*	Kolar	The soft portion is cut into pieces, boiled with a paste of tamarind, dried in the sun and eaten.
145	Eachal hannu ...	Date fruits	*Phoenix sylvestrius*	,,	...
146	Bettada Eachal hannu ...	...	*Phoenix farinifera*	,,	...
147	Jambu Neralay Kayi ...	...	*Eugenia jambulona Var. obtusifolia*	,,	...
148	Kare soppu ...	...	*Canthium parni-florum*	,,	...
149	Kesavina gadde ...	...	*Alacacia antiquo-rum*	Tumkur	...
150	Mara genasu ...	Tapioca	*Manihot utilissima*	,,	...
151	Atti kayi ...	Country fig	*Ficus glomerate*	,,	Cooked and eaten; or dried, ground and mixed with *Ragi* flour and boiled and eaten.
152	Yele genasu ...	...	*Dioseorea species*	Mysore	...
153	Honagonne soppu	...	*Alternanthera ses-silis*	Kolar	...
154	Vishnukranthi soppu ...	...	*Evolvulus alsinoi-des*	,,	...

TABLE I (Continued)

No. 1	Local Name 2	English Name 3	Botanical Name 4	District from which sent 5	Remarks by the Sender 6
155	Hunise beeja ...	Tamarind seeds	*Tamarindus Indica*	Kolar	Seeds fried, husks removed, the cotyledons broken into pieces, boiled and eaten.
156	Thangadi huvu ...	...	*Cassia auriculata*	Tumkur	...
157	Kesavina dhantu...	...	*Alaccia aniquorum*	”	...
158	Chandramallige gadde ...	...	*Mirabilis jalapa*	Hassan	...
159	Bidaru Kalalay ...	Bamboo shoots	*Bambusa aurundinacea*	”	...
160	Vondalaga soppu	...	*Hydrocotyle Asiatica*	”	...
161	Kondal genasu ...	...	...	”	...
162	Noren genasu ...	...	*Dioscorea aculeata*	”	Eaten boiled.
163	Seebe gadde ...	...	...	”	...
164	Byle genasu ...	...	*Dioscorea species*	”	...
165	Bikki kayi ...	...	*Gardenia gummifera*	”	...
166	Makali beru ...	...	...	”	...
167	Goni hannu ...	...	*Ficus Mysorensis*	Kadur	...
168	Alada hannu ...	Banyan fruit	*Ficus Bengalensis*	”	...
169	Ananas hannu ...	Pine apple	...	Hassan	...
170	Gudugudi fruits...	...	*Scutia Indica*	”	...
171	Chelvi genasu ...	...	...	Mysore	...
172	Kavali genasu ...	...	...	”	Eaten raw.
174	Noolina genasu ...	...	...	”	...

TABLE I (Continued)

No. 1	Local Name 2	English Name 3	Botanical Name 4	District from which sent 5	Remarks by the Sender 6
175	Goddirasanida gadde ...	...	...	Shimoga	...
176	Kannay soppu ...	...	*Commelyna communis*	Kolar	...
177	Marakesavina gadde ...	...	*Alocacia spccies*	Mysore	...
178	Kadu nugge soppu	...	...	,,	...
179	Kadu haruve soppu ...	...	*Embelia ribes*	,,	...
180	Koneri gadde ...	...	...	Hassan	...
185	Ale soppu ...	...	...	Mysore	...
186	Navale bhatta ...	...	...	,,	...
209	Hedige genasu ...	Species of yams	*Dioscorea*	Shimoga	...
210	Bagani pith ...	...	*Caryata urens*	,,	...
211	Bella genasu ...	...	...	,,	...
212	Kayi genasu ...	...	...	,,	Boiled and eaten.
215	Kumbha genasu...	...	...	,,	...
216	Anne soppu ...	...	...	Hassan	...
219	Mullu genasu ...	...	...	Mysore	Boiled and eaten with or without honey.
222	Chesaka seeds ...	...	...	,,	Fried, ground and made into gruel; said to produce colic.
226	Poondi soppu ...	...	...	Hassan	...
228	Bale dhantu ...	Plantain stem	...	,,	...
230	Akki thowdu ...	Rice tour	...	,,	...

TABLE I (Continued)

No. 1	Local Name 2	English Name 3	Botanical Name 4	District from which sent 5	Remarks by the Sender 6
233	Byaladakayi ...	Wood apple fruit	...	Mysore	...
235	Bale gadde ...	Plantain root	...	,,	...
240	Chelle hannu ...	...	...	,,	...
243	Yeesha soppu ...	...	...	,,	...
252	Tare kayi ...	...	*Terminalia bellerica*	Kadur	...
253	Bangari kayi ...	...	*Randia dumetorum*	,,	The inner fleshy portion cut and boiled with condiments.
254	Chagache soppu ...	...	*Cassia tora*	,,	...
260	Bidaru akki ...	Bamboo seeds or rice	*Bambusa arundinacea*	,,	Eaten like rice.
265	Myari bhatta ...	...	...	Shimoga	...
268	Kadu ragi* ...	...	...	Chitaldrug	It is stated that ants store 3 to 4 seers of this under ground. People used to go in search of these ant-holes to collect this grain. It is ground into flour, boiled and eaten.
269	Kathale dhantu* ...	Aloe stem	*Agave Americana*	,,	*Eaten during the famine of 1876–77 in Jagalur Taluk.
270	Eachal dhantu* ...	Soft stem of country date	...	,,	...

TABLE I (Continued)

No. 1	Local Name 2	English Name 3	Botanical Name 4	District from which sent 5	Remarks by the Sender 6
271	Jali beeja° ...	Babbool seeds	*Acacia Arabica*	Chitaldrug	...
273	Thavaray gadde ...	Lotus rhizome	*Nelumbium speciosum*	Tumkur	...
318	Pillagala gadde ...	...	*Typha angustifolia*	Chitaldrug	The roots eaten raw or boiled. The roots of one plant said to afford food for 2 persons. Used in famine of 1876–77.
323	Agase soppu ...	Agathi leaves	*Sesbania grandiflora*	Tumkur	...
349	Tupre hannu ...	...	*Diospyros tupru*	”	...
375	Navare hannu ...	...	...	”	...
377	Amle genasu ...	...	...	Bangalore	...
383	Thangadi soppu ...	...	*Cassia auriculata*	”	...
385	Seege soppu ...	Soap nut leaves	...	”	...
386	Hunise soppu ...	Tamarind leaves	...	”	...
391	Solle hannu ...	...	...	”	...
393	Nagare hannu ...	...	*Ximenia Americana*	”	...
422	Kurdi hannu ...	...	...	”	...
423	Burdi hannu ...	...	...	”	...

TABLE II

COMPOSITION OF "FAMINE FOODS"

No.	Local Name	Moisture	Nitrogen	Proteids	Fat	Crude Fibre	Carbohydrates	Ash insoluble in weak acids or alkalis
		%	%	%	%	%	%	%
137	Navare Genasu	8·76	0·86	5·37	0·71	4.45	79·80	0·93
138	Sal ,,	11·11	1·31	8·18	0·76	4·64	74·40	0·97
139	Karane ,,	8·93	1·58	9·87	1·43	14·30	65·10	1·00
140	Kall ,,	8·10	1·08	6·75	1·76	5·23	77·85	0·68
141	Akki ,,	8·26	1·09	6·81	1·60	4·36	79·36	0·32
142	Adavi ,,	8·96	1·17	7·31	1·76	3·48	78·80	0·46
143	Nose Gadde ...	10·28	1·79	11·18	1·12	2·62	74·22	0·56
144	Kathale Gadde	7·96	0·67	4·18	0·45	3·01	84·30	0·06
146	Bettada Eachal Hannu (wild date) ...	9·24	0·63	3·93	0·75	10·29	74·77	0·90
148	Kare Soppu ...	6·77	2·27	14·18	3·14	15·14	59·53	...
149	Kesavina Gadde	6·16	0·91	5·68	0·92	9·99	77·23	...
150	Maragenasu (Tapioca) ...	3·14	0·60	3·75	1·91	7·05	83·23	...
151	Attikayi ...	10·85	1·21	7·56	4·10	15·45	61·66	0·36
152	Yele Genasu ...	6·64	1·48	9·25	2·03	14·81	65·66	1·98
153	Honagone soppu	6·10	3·07	19·18	1·72	15·63	53·47	...
159	Bidaru Kalalay	10·02	4·23	26·43	1·48	12·77	49·32	...
162	Noren Genasu	5·70	0·80	5·00	1·90	10·57	74·19	2·60
164	Byle Genasu ...	9·89	0·72	4·50	2·06	10·67	69·73	3·10
169	Pine apple fruits	9·72	1·08	6·75	0·34	8·58	74·26	0·20
170	Gudugudi fruits	8·54	0·51	3·18	0·54	8·61	78·41	0·60
171	Chelvi Genasu	5·69	1·65	10·31	0·64	9·91	71·87	1·50

TABLE III

"FAMINE FOODS" (partially analysed)

No.	Local Name	Nitrogen %
134	Gutti Gadde	2·86
135	Bendle soppu	1·95
136	Devadari soppu	1·83
147	Jambu-Nerale Kayi	0·82
154	Vishnukranthi soppu ...	2·22
155	Hunise beeja	2·34
156	Thangadi huvu	1·47
157	Kesavina dantu	1·05
158	Chandra Mallige Gadde ...	1·03
160	Vondalaga soppu	1·53
161	Kondal Genasu	0·82
163	Seebe Gadde	1·12
165	Bikki kayi	0·68
166	Makali beru	0·40
167	Goni hannu	1·16
168	Alada hannu	0·92
172	Kavali Genasu	1·37
173	Noori Genasu	1·63
174	Noolina Genasu	1·61
175	Godirasanidha Gadde Hittu ...	0·05
176	Kannay soppu	2·70
177	Marakesavina Gadde ...	1·34
178	Kadu Nugge soppu	2·18
179	Kadu Haruve soppu ...	1·51
186	Navale bhatta	1·64
209	Hedige Genasu	2·11
210	Bagani pith	0·06
216	Anne soppu	2·44
224	Bidaru Akki	1·80
226	Pundi soppu	3·33
230	Akki thowdu	1·57
253	Bongari kayi	0·69
254	Chagachi soppu	2·32
259	Kayi Genasu	1·27
268	Kadu Ragi	2·65
270	Soft stem of country date ...	0·84
271	Babul seeds	6·06
273	Lotus roots	1·77
277	Deva Genasu	1·18
323	Agase soppu	4·67
375	Navare hannu	2·00
349	Tupre hannu	0·26
385	Seege soppu	4·97
386	Hunise soppu	1·83

FOOD FROM UNUSUAL SOURCES AND WASTE MATERIALS

by

T. A. Venkitasubramanian and S. S. De

(*Indian Institute of Science, Bangalore*)

India's Food Problem is characterized by an over-all deficiency of 10 per cent with respect to her food-grains. Food Technology can give an answer to the problem by processing unusual food materials and waste products into edible form at economic prices. The use of processed foods will improve the general nutritional level of Indian diets. Several sources from which nutritious and inexpensive food products can be developed are discussed in the paper.

The agricultural production of India has remained stationary for some time despite ardent efforts made by the Government to increase production. At the same time the population of the country is steadily increasing at the rate of about 5-6 millions every year. The result has been that India which was self-sufficient with respect to food-grains up to 1938 had to import about 800,000 tons of rice, 250,000 tons of sorghum and other millets and 2,291,000 tons of wheat and wheat products in the year 1950 just to distribute a minimum living standard to her growing population. India suffers from an over-all deficit of 10 per cent with respect to food-grains, the wheat and rye production meeting about 78 per cent and rice to the extent of 95 per cent of the country's needs. The net result has been that a large amount of money is being spent every year just in importing food-stuffs. This stands in the way of any good portion of money being spent for other and more important nation-building projects. But for the timely loan of two million dollars worth of food-grains from the U.S.A. the chances of India having to face a food famine in the country this year were very near. Even though the area under cultivation is increased, because of the dense and growing population the

quantity of food produced per head of population becomes insignificant.

Technological researches in food processing could be profitably canalized in the direction of improving the Indian dietary with respect to quality and quantity from the nutritional point of view by making available large quantities of nutritious food which is not being used at present for edible purposes to any large extent. Suitable processing will help in making available food containing considerable quantities of proteins, vitamins and minerals. The average Indian dietary is poor with respect to animal proteins and B-group of vitamins in addition to the gross deficiency in calorific value. 'Enough food' is the primary need in this country. The pioneering work of the Central Food Technological Research Institute at Mysore in developing synthetic rice from suitably processed materials, which are not very popular as human food before processing, is an indication of the part that the food technologist can play in solving the present food problem of the country.

The majority of the Indians are vegetarians both due to economic reasons and religious scruples, and suitably processed foods from vegetable sources which are being wasted now would go a long way in ameliorating the present food shortage and giving the population an adequate diet of vegetable origin. The low economic level of the people makes it impossible for a large majority of them to buy supplementary foods like milk, fruits etc. The foods to be recommended for the average Indian should therefore be quite cheap.

The use of processed oil-cakes as a food material offers unlimited scope inasmuch as it is cheap and at the same time quite a rich source of good quality protein, B-group vitamins and minerals. The oil-cakes of groundnut, cottonseed, sesame and cocoanut are available in large quantities and are now mainly used as cattle-feed or as manure. The following table gives the total production of the more important oil seeds per annum.

Oilseed	*Acreage (million acres)*	*Output (million tons)*
Cottonseed	25·0	2·0
Groundnut	10·0	3·3
Mustard and rapeseed ...	7·0	1·0
Gingelly	5·0	0·6
Cocoanut	1·3	1.1

India produces a good portion of this total output. The oil-cakes produced in this country are used to the extent of 50 per cent as manure and the remainder as cattle-feed. With the advent of synthetic fertilizers the oil-cakes can be easily diverted as human food after processing. Experiments conducted in these laboratories have shown that by careful processing a very good food with high supplementary value to a rice diet can be obtained from groundnut cake. The proteins can easily be separated from the oil-cakes, if necessary. Groundnut cake is a rich source of protein, contains quite a good amount of B-vitamins as also the mineral calcium. Its value in calories is about the same as that of wheat flour, *i.e.*, 357–365 calories per 100 gm. It has been found that groundnut flour proteins can satisfactorily replace meat protein.

The most simple method of using the groundnut cake flour is the incorporation of a certain percentage of groundnut flour with other cereal flours. Preparation of various food specialities such as soups, sauces, biscuits and different types of bread can be made without seriously affecting the taste of the products. The defatted flour has proved very successful as a substitute for casein in the so-called caseinated biscuits. A mixture of groundnut cake, cottonseed cake and processed soya flour has been found to be a good substitute for meat. As a result of the researches conducted in this direction, this laboratory has been able to prepare a very nutritious food from the oil-cake flours and tapioca after suitable processing and mixing in correct proportions. The food has been found to have great consumer acceptance from the point of view of taste, palatability and the diverse ways in which dishes can be prepared from it. It is quite balanced in almost

all the essential amino acids, B-vitamins and minerals. Large-scale feeding experiments are being conducted now with a similar type of food. The dried and defatted cocoanut oil-cake has a fairly high protein content and is moreover rich in the essential amino acids, lysine and methionine as compared with other oil-cakes. It can also be used with advantage as a supplement to our present diet.

The oil-cakes as produced in commerce present an unattractive appearance and also contain grit and other undesirable materials which should be removed before processing. The residual oil left in the cake should also be reduced to the optimum to prevent rancidity developing in the flour. The processing and nutritive value of other oil-cakes available in quantity needs further study.

The mango seed kernel and jack fruit seeds have been found to be good sources of protein. Until now almost the whole of mango seed kernels and a good portion of jack fruit seeds have been going to waste. A number of palatable and tasty recipes have been prepared from mango seed kernels.

Another line of food processing would be the utilization of molasses for yeast production. In our country a large quantity of molasses goes to waste. Yeast is one of the most efficient proteins manufactured from the cheapest raw materials of any food. Two of the major defects in many of the modern diets are relatively small provision for certain vitamins of the B-complex group and an insufficiency of biologically superior protein. Both the deficiencies could be lessened by using yeast as a supplementary food. It also contains ergosterol which on irradiation is converted to vitamin D. Germany is now producing 100,000 tons of food yeast yearly. Dried yeast can also be produced as a by-product of breweries and distilleries. The brewer's yeast could be debittered and then used as human food. The Technical Committee on Nutrition of the League of Nations (1938) recommended the inclusion of yeast in tropical diets. A small daily intake of 7–15 gms. of yeast is sufficient to supply additional protein and vitamins in requisite quantities. It has proved of great help in improving the nutrition of people in Japan, Germany, Nigeria and England.

To meet the calcium deficiency large quantities of green grass or leafy vegetables should be grown and dehydrated. Pumpkin leaves, cabbage and Amaranth are rich sources of calcium. Experiments have shown that calcium from these sources can be well utilized in the system. A cereal crop like rice can yield 1,000–1,500 lb. per acre producing about 750 lb. of finished edible material. A leaf crop can yield 20–50 tons or more per acre. Even allowing for the comparatively high moisture content the net dry weight will be many times more than what can be obtained from a grain crop. If dried and processed food from leaves is available in sufficient quantity it can be added in any desired proportion to the available supply of cereal food.

Roots, tubers and other starchy foods flourish in tropical and sub-tropical soils and give high yields. Tapioca, sweet potato, yam, bananas and plantains come under this category of food materials. There are of course some differences in the nutritive value of various members of this group. Starchy roots are poor in protein and devoid of fat. But, from the point of view of yield of calories per acre, these crops are better than rice. In fact, the production of tapioca on a large scale has prevented starvation in some parts of the Far East during recent years. In Java and Madura about 180 kg. of tapioca are being consumed per head per year. A variety of dishes have been prepared from processed tapioca. In India it is being taken as 'artificial sago' and in the form of synthetic rice. An admixture of sweet potato flour and groundnut meal will be an ideal foodstuff which will be rich in protein, B-group vitamins, vitamin C and calcium.

In the United States, the fish livers after the extraction of the fatty oil have been processed to yield a satisfactory food. Britain has also developed a method for the dehydration of minced fish. Fish is a rich source of calcium. India is producing a large quantity of shark liver oil. The rejected shark flesh which is a by-product of the shark liver oil industry needs consideration as an article of human food. If dehydrated, its valuable protein would be good for human food, stock-feed as well as manure. The large quantity of fish offal produced in the fish dehydration industry would provide a good source of fish meal by drying in

rotary driers. Keeping quality tests of dehydrated minced pre-cooked fish show that it can be preserved for about three months at 100°F without losing its edibility. Fresh water fishing, in-shore fishing and off-shore fishing should be developed to such an extent that by the help of modern science and technology striking advances in the health and nutrition of the people in this country could be made as has already been the case in other parts of the world.

The conversion of bone and meat offals left during meat dehydration into valuable material is particularly important. At present, meat dehydration factories in our country have got a lot of offal which is not being processed. Such offals are processed to a rich protein source containing large quantities of B-vitamins in the U.K. and U.S.A.

The utilization of wheat germ, rich in minerals and vitamins, hardly needs any emphasis. It is very rich in B_1, B_2 and E vitamins. Rice polishings stand next in order of importance to wheat germs as superior to any other cereal.

Thus, by suitable food processing balanced and nutritious and at the same time economical foods can be developed from sources which are not used as food materials at present. The food technologist can also correct the malnutrition existing now by proper blending of foods and proper choice of food materials.

References

The Famine Enquiry Commission, Final Report, Madras, Government of India Press, 1945.

Accessory Factors Committee, Medical Research Council, Food Yeast, (War Memoirs. No. 6), London, 1945.

Basu, K. P., Studies on Protein, Fat and Mineral Metabolism in Indians, I.R.F.A. Report, 1946.

De and Subrahmanyan, Report on the Nutritive value of soya-bean milk, I.R.F.A. Report, 1949.

PLANNING FOR FOOD EMERGENCY

by

V. Subrahmanyan
(*Director, Central Food Technological Research Institute, Mysore*)

It has been stressed that the menace of increasing population and its food requirements should not be underestimated. Taking food crisis to be inevitable we should be prepared well in advance. Supplementary foods such as tapioca, sweet potato, vegetables etc., are some of the dependable sources. Tapioca which is rich in starch can be suitably processed in combination with easily available proteins as found in groundnut cake flour to yield 'synthetic grains'. Synthetic grains prepared out of tapioca flour and groundnut cake flour have been found to be as nutritious as rice. Tapioca is known to yield as much as 10–12 tons per acre. The success or the popularity of synthetic grains as well as other products of tapioca such as tapioca SOJI *and flour lies in the support the public gives in taking to their use. Measures on a war footing alone can succeed in dealing with our food problem. Inclusion of tuber products as compulsory quota to the extent of 1 oz. per capita in our normal ration of grains will help in overcoming prejudice and in the increased production of synthetic grains, and other tapioca products.*

THE previous contributors have dealt in sufficient detail with our population trends in relation to our capacity for production. With the present average increase of 4.5 millions per annum, we will require 400,000–500,000 tons of extra food-grains per year. This would mean that we will either have to go on increasing our yield from land, from year to year, to this extent, or have to bring one million more acres of additional land *every year* under cultivation for food grains alone. We will also require additional land for other forms of food materials, for our milk, oils, vegetables, clothing etc. Even the most optimistic agriculturist will not claim

that such a thing is going to be possible, on a steady year-to-year basis. Added to that, if during any year either or both the Monsoons should fail, we will be faced with a terrible disaster. The experiences of 1943 and 1945–46 are still fresh in our memory. Without being unduly pessimistic, we will be justified in concluding that, at the present rate, a crisis is inevitable and that we should prepare for it in advance.

The main component in our diet is starch which forms about 60 per cent of the food of the majority of population. If we are to avert a famine, we should first obtain substantial quantities of starch-bearing materials. Starch has also various industrial uses and we require very large quantities of starch even at the present time. The island of Java produces over a million tons of *Cassava* (Tapioca) primarily for export and for industrial use, but, at the same time, as a stand-by in times of emergency.

Apart from the grains, tubers and particularly tapioca and sweet potato are two very rich sources of starch and of these two, tapioca is generally the more acceptable. In the delta districts a yield of 10–12 tons of tapioca per acre can be obtained. Even on poor soils in other parts of the country, a minimum yield of 2–3 tons can be obtained. In other words, we can obtain anywhere from 3–10 times as much of starchy food per acre in the form of tapioca as we can do in the form of grains.

Realizing our present position, we have, during the past two years, carried out intensive studies on the effect of replacing cereals in our diet to the extent of 25–50 per cent with tapioca or sweet potato flour. In spite of the lowering of the protein content of the diet, we found that the growth response of experimental animals was as good, if not slightly better than on cereals alone. We have ourselves repeated the experiments four times and two other laboratories in the country have also repeated them independently, with similar results. This remarkable phenomenon is due to the high calcium content of the tuber, which is 4–6 times that present in rice. *We have recently done human feeding experiments with the same materials and have found that the protein balance is unaffected through replacement of rice with tapioca to the extent of 25 per cent.* Strange as it may

appear, this finding gives us a ray of hope for the immediate future. By either changing over a part of our present area or by bringing additional area under tapioca, we can obtain more bulk food per acre and thus avert an immediate crisis.

Apart from the above, we have succeeded in suitably combining tapioca with good quality groundnut flour and producing a synthetic grain which is nutritionally as good as rice. We demonstrated the production of the grain on a pilot plant scale in Travancore-Cochin and no less than a lakh of people saw the actual work. The State is keenly interested in the production of at least a hundred thousand tons of grains in the near future. The grains that we now make are round, but given the necessary mechanical equipment, we can make beautiful, white rice-shaped grains which can satisfy even the most fastidious consumers.

Sir John Orr advised us and the Honourable Prime Minister has repeatedly confirmed that we should place ourselves on a war footing for dealing with our food problems. This will mean that the country will recognize the need for a determined and disciplined approach to the subject. When the last War started, the British expert Sir Jack Drummond advised that they should stop the import of bananas and whole oranges as they are unnecessary and occupy a lot of shipping space. They also advised that people should reduce the consumption of meat and use more of potatoes which they could grow on their own land. The Government accepted their advice and the people responded gallantly. As the result of this, the country had enough food to go round and the public health actually improved considerably. If we are to pull through the impending emergency, we should adopt a similar procedure. The grains that we are now importing at so much cost will serve as a stand-by, but we should soon turn to alternative foods.

At the present time, there is considerable amount of prejudice against the use of tubers and particularly of tapioca over a large part of the country. The public have, however, learnt to use the flour and the *soji* both of which can be easily prepared out of tapioca. About a year ago, I made bold to suggest that in view of the impending emergency, we should make the flour or *soji*

or both as a part of our ration at least to the extent of 1 oz. *per capita.* If people are compelled to buy at least a small quantity, as a pre-requisite for obtaining their normal grain ration, we will automatically create a definite demand for the products and the increased production will automatically follow. This proposal is a safe and a practical one and is supported by the scientific evidence that is steadily accumulating. Judging from the trends, one cannot help feeling that whether we like it or not, we will soon have to choose one of the two alternatives; either to produce and consume more tuber products and thus be prepared for an emergency or to face the grain famine which is bound to come sooner or later. The choice is obvious.

Even the replacement of a part of our grains with tuber products will not constitute a permanent solution if our population continues to increase at the present rate. The country will have to go full out for introducing practical birth control if we are to survive as a self-respecting independent Nation.

One more word before I conclude. Worse times are yet to come. We all have our prejudices and preconceived ideas, but they should be put aside in times of emergency. Scientific evidence is always open to verification, but once the facts are established, we should accept them and advise the Government accordingly. The State should accept such advice and act accordingly. It is yet not too late. If, on the other hand, we continue to pull in different directions, the country will not have proper guidance and there will soon be nothing but chaos and ruin. The whole of the present order will collapse and all the organizations and the institutions that the country has built up will disappear.

SRI R. M. SUNDARAM, I.C.S., (Secretary, Food and Agriculture Department, Madras):

I should like to say just a few words about the food problem in Madras. I am not going to say in detail what little we are doing. You have heard from my friend, the Commissioner for Food Production in Mysore, the steps taken in his State. We are doing almost exactly the same and I wish to touch upon one or two points, on this occasion.

Everybody puts the problem of agriculture first. We are all conscious of it. I am not such a pessimist to think that there is no hope at all in agriculture in this country. But I am one of those to say that it is possible to overcome the difficulties with improved agriculture. Unfortunately, we have had adverse seasons and these clouded our outlook. At the present moment, a lot of criticism has been levelled against the GMF Campaign and people have said that a lot of money is wasted as it is a drain on public money. I am afraid that this is an unexpected criticism. We should look at it the other way. If we had not done this, the present position would have been perhaps worse. We do not have a machinery which can correctly assess the results of GMFC. We all know that we apply a certain quantity of chemicals and fertilizers; we do expect an increased yield but for assessing the increase in yield, we do not have a machinery to give concrete figures for all the country. But this is not to say that nothing has been achieved. We are quite conscious of the criticism that any steps we have taken in this direction, say by using fertilizers, improving irrigations etc., or bringing new lands under cultivation—we are conscious that these things are not reflected through the procurement figures. That, of course, is really a sad thing. But it cannot be helped. It is impossible for us to go and procure from millions of small cultivators. That is why we have an idea from last year of changing our efforts to what we call 'intensive cultivation' plans, *i.e.*, we are going to select areas where there is assured water supply, for example in the deltas in the Northern Circars, we can certainly show that figures of procurement are improving day by day. That is why we have

launched upon the intensive cultivation scheme where water supply is assured. You might know that in the various measures that we adopt such as fertilizers, improved seed etc., each item has got a certain specific value. Scientists say that there is definitely an increase of 10 per cent owing to the use of good fertilizers and adoption of improved methods. So also in the matter of irrigation. We have been told by many eminent men that within a particular space by the use of improved seeds, good fertilizers and increased irrigation facilities the effect derived will be manifold. And that of course is a thing which has been proved by scientists over a particular area. We want to come in touch with almost every ryot and see what his requirements are.

Some time ago, we found in a delta district in Madras, people saying they would not use chemical manures etc. The reason why they say that they cannot use this chemical manure is because it is a *new idea*. But when they did have intensive campaign with these chemical fertilizers etc., the results were remarkable. What we did was simply to educate the people with these ideas, to pay our attention to the ryots' needs and provide them with more finances. Even in a rich country like America loans are given for fertilizers on a very liberal measure. We adopted similar measures and gave Rs 25 per acre as loan in certain proportions and it was a very great help to them and the results were remarkable. It added inducement because the loan was free of interest and repayable immediately after the harvest. Remarkable yields, 8–9 thousand lb. paddy per acre were derived and we have thus proved even here in this country that we can step up production very considerably. Only we have to ask the ryot what his requirements are. People may say that price factor is a very important one but price factor alone is not everything. It is not possible to have every ryot to grow only commercial products. Lands suitable for one type of commodity growth cannot be used for another type of crop. There should be a planning for doing anything. If some amount of co-operation is forthcoming from the ryot, I am sure, that with the mechanism, satisfactory results can be achieved. We have therefore taken in Madras a scheme of extension service. We have listed enlight-

ened and elite farmers when the other ryots will fear. So, these people will be able to discharge their duties better than Government officials who are not well up in these lines. Our aim is to extend the agricultural staff so that in almost every village there should be a qualified agricultural expert. One graduate is in charge of a particular area now.

I trust that, in the new scheme of G.M.F.C., our ideas will be intensive cultivation with excellent extension service; therein lies the salvation of G.M.F.C.

SRI J. M. LOBO PRABHU, I.C.S. (Secretary, Development Department, Madras):

I came here very anxious to know how this very important problem—problem of the greatest magnitude, namely, the relationship of food with population would be discussed here. I would like to say that I was surprised at the concrete suggestion that emerged. One was about the artificial restriction of population; another was one given in more details by Dr V. Subrahmanyan that we could considerably increase the quantity of food by introducing certain artificial foods. Both these suggestions presume a human factor—whether the population is willing to accept these artificial methods and means.

I have a different proposition to place before you. If you are thinking in terms of securing these human factors, are there no other factors? I refer to Mr Sundaram's speech. He told us that we can produce 10,000 lb. per acre as against the average of 800–1,000 lb. by stepping up food production. What will it work out to?—1,000 per cent—against food deficit in Madras province which is only 5·7 per cent now. I am asking, are there no means available with us to make it possible to enforce these methods that Mr Sundaram has been telling us! That is a fundamental question which an Assembly like this should consider before it considers other measures like supplementary foods or restriction of population which presume certain human factors. We can achieve a great part of what Mr Sundaram said, if not the whole, by making the people work hard. A cultivator is working only

120 man-days in the year. Can you not make him work all the days in the year? These are problems which I would like to suggest as remedies at the present time. The remedies suggested are that you have tried so far to approach individual agriculturist but not the whole system of agricultural unit by a demonstration in this province on an extensive system. The agricultural system, if it is to approach the individual, is not able to persuade him very much, as otherwise, there would not have been continued reduction in the food production of the country. We have something which can be stronger than this and that is the 'extension system'. I may propose that as in the past, we have to get the village itself mobilized against the individual to raise the production of that individual and of the whole village. That is to say, the village must be charged to raise production by a definite percentage. A target must be fixed. And this can be done by offering a certain remission in land revenues and by restricting State services only to those persons. Now, there is only one more argument although the idea is new. Apart from the cultivator there is a very large population which is unemployed. In Madras City there is an influx of 100 people every day seeking employment. What are you doing with the labour of this population. I would like to propose another scheme. These people, if they are given food and given certain area to work, they will be able to produce something for themselves and for the country.

Subsidiary foods and intensive schemes are going to deal with these problems in very small instalments. You are now importing 5 million tons of grains and you are sacrificing more than 50 per cent of foreign exchange on this one subject. Instead, you have to think in terms of mobilizing the entire labour force for the task of free India and making India really independent of food supplies.

DR B. N. LINGARAJU, (Professor of Hygiene, Medical College, Mysore):

Having listened to the valuable discussions held so far, as a member of the Public Health profession, I am tempted to impress

upon you one thing, that is, the relationship of health with food and population.

It is accepted that one must have health to be able to grow or to consume food. Regarding the population problem in our country, to my mind, more than the population pressure, the wastage caused by our lowered vitality, ill-health and low expectation of life seem to be responsible for the hindrance to our socio-economic progress. As a matter of fact, the average expectation of life in India is only 27 years as against 67 years in the more advanced countries. Most of us therefore do not live up to the age of productive capacity in terms of economic value to the community. As some statisticians have estimated, while the economic value of a man to the community in the U.S.A. is of the order of Rs 54,000, it is reckoned at about Rs 500 in India, which means that the value of man-power per person is over 100 times higher in the U.S.A. than in India. So, I believe that in spite of our great bulk of population, our productive capacity in relation to food and other needs is extremely poor, hence the difficulty to sustain ourselves. Further, socio-economic status appears to have a bearing on population problem. It is a common observation that low-income groups have relatively larger families than the better-class groups of people. Since our socio-economic status at large is miserably low, we must naturally belong to that group of population prone to have relatively larger families than the economically better class communities, which appear to have a lower capacity to add to their families. Though this is an observation with no definite scientific basis, it may be possible to check, to some extent, our abnormal rate of increase of population if our socio-economic status could be raised to a reasonably satisfactory level.

Regarding 'Grow More Food' plans, I would like to bring to your attention the fact, that in our attempts to grow more food, we are apt to ignore the consequential events leading to added ill-health. To quote an example, I would take the case of the introduction of large-scale irrigation in Mandya from the Irwin Canal. With the addition of wealth from sugarcane and rice, there came the scourge of malaria, which reached hyper-endemic

state with all its ill-effects. This involved planning of malaria control operations on an extensive scale and at enormous cost to check this evil. This emphasizes the importance of the consideration to be given to the health problems that may arise out of any plans for increased food production. So in our planning for 'Grow More Food', the factors of water sanitation in relation to health should not be lost sight of. The Public Health Engineer and the Medical Officer of Health have a large part to play in the prevention of the potential health hazards.

SRI R. B. RAO, (The Britannia Biscuit Co., Ltd., Bombay):

There has been some reference to groundnut flour, regarding its utilization. In our country, six million tons of this product are available of which the average oil content is about 10 per cent. By solvent extraction method we must be able to get 600,000 tons of oil as well as fat from groundnut flour. At the present time, we are unable to get high-grade peanut flour to substitute anything up to 25 per cent, in biscuit and confectionery products. The experiments conducted in our factory with Bhavanagar peanut flour are not encouraging. It is almost wasting good wheat flour if we use it in confectionery; hence I appeal to the authorities concerned to improve the methods of extraction of oil from seeds and to install more solvent extraction plants. There is only one unit in this country at the moment and our needs demand at least five more plants. By this, we will be able to save five milion tons of groundnut flour, containing a high percentage of proteins, which forms as a protein supplementary food for tapioca flour and sweet potato flour. I am sure, we can very well use this in the confectionery product, so that the consumer may not realize that it contains peanut flour because a processed food like Biscuit contains so many other materials that their presence is not felt.

Mr Lobo referred to the synthetic grains, birth-control methods and told that implementation of these will be difficult since they are human problems. I cannot see how Mr Lobo's proposition is not human, since our agriculturists do not believe in

what we tell them regarding fertilizers, mechanization etc. Hence it is essential that we make extensive programme to popularize all these ideas on a nation-wide scale. Regarding birth-control, sometime back in Bombay they opened two advisory centres but response was poor in the beginning and only twenty people took advice. But, at the moment there are about seven such centres and, on an average, 500 people are taking advice per month. Hence I do feel that we have to tackle the problem from all the angles—firstly, to check the growth of population and relieve the pressure on land, secondly by the use of improved and new subsidiary foods, and thirdly, by the schemes of intensive cultivation.

SHRIMATHI P. C. REDDY. (Headmistress, Government Girls' High School, Hassan).*

It was with considerable interest that I heard the discussions today. Suggestions were made to introduce unrationed and synthetic foods to make up for the insufficiency of staple foods in the country. It was also remarked that people were slow in accepting tapioca and other substitutes for staple foods, substitutes which would help in bridging the gulf of disparity caused by a fast-growing population.

As I listened to the eminent speakers, I realized that in modern times with the rise of world trade in food-stuffs, the development of the Science of Nutrition and the growth of national and international agencies concerned with agriculture, change has become a matter of conscious planning. But, all the changes, important as they are, can have little final reflection on the lives of the people as a whole, unless the house-wife who chooses, buys and prepares the food, accepts the new food or the new method of preparation and puts it into practice. It is she who by using food as an expression of motherly love or wifely devotion, or withdrawing it as punishment, lays the groundwork upon which individuals accept or reject, enjoy or

* Now, Head, Department of Domestic Science, Maharani's College, Bangalore.

merely tolerate each food in the dietary pattern. In each society in which those concerned with the health of the people wish to make changes in the dietary pattern, a way must be found to reach the millions of women cooking supper over coal or firewood or electric ovens in brass, aluminium, enamel or clay pots. It is difficult to get adults to come out and attend meetings of this type and discuss about them. Our women especially are hard to be collected and convinced. How then can they be approached? Who is going to bell the cat? I am convinced that the surest way to achieve success in making these foods popular is by introducing them in school lunches, where children will learn to eat and like them and will in turn advertise their values to parents at home. Every child wields a great deal of influence in the home especially in the kitchen, because mothers take immense delight in satisfying the tastes of their children. Knowing this to be true, I assert that it is absolutely imperative to start this education not so much from the basis of adult education but from the angle of children's interests in food. By telling the idea of these unrationed and synthetic foods to the children in school, a two-fold result will be achieved: the education of the future generation in the acceptance of foods of nutritive value and the gradual change in the food habits of the people as a whole.

During the last Dasara season, I was asked to help conduct a competition on 'Practical recipes for complete dinners out of non-rationed articles' organized under the auspices of the Ladies Section during the Exhibition Week. Even though handsome prizes were offered to winners of the competition, there were no entries. This proved the inability of the public at large to cope with the non-rationed articles, and it was also a clear proof of the lack of self-confidence of the house-wife who did not know how to use these articles in the preparation of meals in Indian homes.

It will be a great boon to the public, if this worthy Institution could arrange to send out people to demonstrate the methods of preparation as well as the nutritive values of these foods to various schools in the country. 'Demonstration on wheels' has

proved very successful and educative in the rural areas of America and Novascotia, and I have no doubt that great benefits will accrue from this type of dissemination of knowledge in our country also. Vans thoroughly equipped with visual aids as well as demonstration kit and personnel, could go round to different large towns and demonstrate the preparation of these foods to gatherings at which mothers and children are present. Teachers conducting Home Science classes in schools could be given short Refresher Courses in the use of preservation and preparation of foods in general and that they also could be introduced to the hidden lore underlying non-rationed and synthetic foods. Clubs could be instrumental in encouraging women to vie with one another in the preparation of these foods.

It will also be a great asset to the public if the 'Publicity' Department of this Institute could give the lead to the various plans of food industries in drawing up inviting menus with attractive illustrations to be circulated through pamphlets to homes. These could be made in English as well as in regional languages.

This type of training, will, I am sure, bear fruit in the near future in producing a healthy and strong nation, so greatly desired in a free country like ours.

SHRIMATHI LAKSHMI P. KRISHNAPPA, (Indian Red Cross Society, Bangalore):

At present most of our middle-class men visit hotels just to supplement their food. The so-called 'hotel tiffin' is far from being a balanced diet. In the West, even the school lunch consisting of bread, butter, cheese, a pint of milk and a raw fruit or vegetable supplies as many as 900 calories. In fact, our malnutrition is due to the fact that we do not know what best to eat. Our standard menu should be so planned as to present a well-balanced diet and at the same time be within the reach of families of low income groups. According to Dr Aykroyd, the well-known nutritionist, the temple offerings consisting of, *Kichari, Daddyoadhana,* (rice and curd) and *Rasayana* (plantains, ghee and honey) even in small quantities make a well-balanced

diet. Therefore, one ought to examine this problem of food in the light of past experience, and learn to use our food crops in such a way as to get the maximum benefit out of them. I should like to make, in this connection, a few practical suggestions: First, in addition to the usual rice and curry, our food may be supplemented by 'HURIHITTU'—*ragi*, slightly germinated, dried, roasted and reduced to powder and taken as a breakfast porridge on which we and our children have thrived so well. I speak of it from personal experience. In Europe, rye bread is made as palatable as wheat bread. Secondly, 'USALIS': green gram and Bengal gram, boiled and seasoned, now considered plebian, make great nutritive food and have high sustaining value. Thirdly, 'KOSAMBRIES': soaked, green gram and Bengal gram *dhal*, taken raw but made appetizing by proper seasoning, were a permanent feature of our meals; the present-day house-wife has forgotten this and thus lost the chance of replenishing the diet with fresh proteins and vitamins. Fourthly, germinating green and Bengal gram were not only popular but insisted upon on certain days of the week, as well as for the nursing mothers during the first three months. These were also taken raw. Such articles of food taken raw are called 'AMRUTHANNA' ('Food for Gods' or also 'Food that is not dead, *i.e.*, cooked').

Our mothers and grand-mothers had a variety of ways of making food palatable and sufficient with the usual food materials. Ignorance in the better-class women and over-work in the lower-class women has contributed to the present deplorable state of affairs.

This leads to vegetable gardens which every housewife should and ought to maintain if she has a compound or even a backyard. A couple of papaya trees, a couple of cocoanut palms, a small kitchen garden and a drum-stick tree will solve 30 per cent of the vegetable problem to release the pressure on the market for the benefit of those who have no compounds for gardening.

In Europe, vegetable gardens of Boarding Institutions are maintained by children and old people only. Be it a Children's Home, Old Age Home or Mental Hospital,

or hostel attached to an educational institution, it has its own fields and gardens and grows most of its requirements. In addition, they raise their own eggs, meat and milk by maintaining poultry, pigs and cows. This necessitates that at least all new institutions of this nature should be located not in urban areas but outside it, so that in addition to other advantages, there will also be sufficient space for such extra-curricular activities as gardening and animal husbandry. Incidentally, this will also help in training young boys and girls in their impressionable age for doing things for themselves and inculcate in them a spirit of self-help and dignity of labour. The concern of the administration would then be to show what is best in life and how to get it by fair and honourable means.

Thus, it behoves all responsible people to see that such education is included in the training of all Secondary Schools. Further, the preparation of standard menus and meals should also form a part of the course of study. In most Scandinavian countries, cooking and gardening and care of animals have been included as a practical course both for boys and girls from kindergarten to Secondary Schools. What is learnt at tender and impressionable age is bound to be remembered and cultivated. Classes in Domestic Science should give detailed training in the preparation of standard menus of balanced diet in addition to other subjects like house-keeping, budgeting, laundry, etc.

Further, in most European countries, there are Housewives' Co-operative Institutes and Home Research Institutes where a Committee of Women sponsor research on all household matters, food and its selections and preparation, and work out standard menus on balanced diet and publish them in their monthlies and journals for the benefit of all.

Such research should be encouraged here with regard to our food requirements so that there is no wastage due to: (1) Careless discarding, (2) Wrong use of materials, (3) Indiscriminate selection or (4) Wrong taste for only luxury articles.

Our land abounds in food grains and materials rich both in content and in variety. South Indian menus, as I know, are both scientific and economical. As such, not only we have to dig

deep the soil but also revise our methods of selecting and preparing the foods if we wish to solve the food problems in our country.

We have land, we have man-power. What is required is intelligent effort to utilize both and the food produced by them.

SHRIMATHI A. S. R. CHARI, (Women's Food Council, Bangalore):

So many of us are speaking about the food problem and of the imminent danger and troubles that we have to face in the very near future. It was said that our Indian women paid more attention to food in the last generation. It is not only important, but especially in a country like ours, I am afraid, we, women, have to take more initiative on the question of limiting our family. We have to pay more attention to the population factor. We should not allow the rapid increase that is going on now. We have to go about and teach our people the absolute necessity of limiting the family. Side by side, the Government will also have to take more interest in the Grow More Food Campaign. Unless we limit the increase of population there is no use in thinking of our Grow More Food schemes.

We can also do more in the way of substituting our foods. This is also necessary. We have to stop all sorts of wastage. There is so much of wastage for want of knowledge, and due to ignorance especially among the working classes—in the higher classes also, because most of the higher class ladies do not go to kitchen and they leave the kitchen to servants, taking to social work outside. I believe our social work has to be started in our home and kitchen in future. I hope, we will all take the initiative in bringing our country to a state where the aim will be to produce a quality population and not quantitative one.

If along with the increase of acres of land brought under cultivation, the population increases abnormally, the effects of the former will be neutralized and the problem of scarcity and famine will remain as acute as ever. What we give with one hand we take away with the other. Therefore, tackling the overgrowth of population is even more important than increase in food

production. We are now realizing the truth underlying Malthusian theories. Better late than never.

SRI P. KODANDA RAO, (Servants of India Society, Bangalore): As a layman, I would not have intervened in the symposium of experts, but for the speech of the last speaker, Dr Subrahmanyan, whose description of the imminent food situation in the country, coming as it does from one of his great authority, must cause grave concern even to laymen. It seems to me that the several solutions propounded by the previous speakers were, at best, long-range remedies. For instance, birth-control, recommended by Dr S. Chandrasekhar, would take years to give the requisite results, considering the preparatory work to be done. Similarly, the production of more food by means of irrigation projects, fertilizers, etc., would take time, perhaps years. They are no answer to the present question, which is: what are we to do in the next twelve months to increase the quantity of food in the country? In so far as the fall in production was due to natural causes like the failure of the monsoon, it would not be remedied by money grants to cultivators. The Grow More Food Campaign was a failure, in spite of the moneys lavishly spent on it by the Government of India. The Agricultural Department failed to meet the challenge of increasing food production by the five or six per cent needed to meet the food gap in the country. Consequently, in spite of the Hon'ble Shri Jawaharlal Nehru's determination to the contrary, the Government of India have been obliged to import food from abroad, at a heavy sacrifice of much-needed foreign exchange, and driven to the humiliation of accepting food-charity from abroad.

The most urgent question is: what shall we do in the next twelve months to increase food production to feed the people? As I said above, most of the suggested solutions were long-term projects. Further, if each expert gave his own and different solution, what is the public to do? And what is the Government to do? If the experts would put their heads together and suggest a single and immediate solution, it will be very helpful to Government and the public.

It seems to me that the only practical solution for the immediate emergency was the one made by Dr Subrahmanyan, namely, substitute food from tapioca, which, according to him, can be grown within twelve months. I wonder what stands in the way of taking up the production of fortified tapioca on a large enough scale.

THE HON'BLE SRI J. L. P. ROCHE-VICTORIA, in his concluding remarks, said:

As stressed by the last speaker, the question is how to meet the present situation. Long-term schemes and proposals for increased production and keeping down the population, all these are good suggestions for thought, but what about the immediate needs of the people? When Dr Subrahmanyan requested me to come down from the Nilgiris and asked me to preside over this Symposium, I accepted it because I would be getting some of the specifics for the headaches that Food Ministers have in meeting the food situation. We can see from the papers today the Hon'ble Shri Munshi, though he has been successful in his negotiations in Burma and other countries, still saying that the present success will carry us only till August. The time beyond August appears to be still a problem. That is why the question was raised by one of the speakers (Shri Kodanda Rao) 'What are we going to do for the next twelve months.' This must receive our immediate attention, and serious attention too! I should have very much liked that either the Hon'ble Shri Sri Prakasa or Shri Munshi should have been here to hear the speeches and give opinion on the papers read and also the views expressed by different speakers who can speak with some authority on the subjects they are dealing with. Unfortunately, they have not been able to come, but we have amongst us some officers from the Central Government, who, I am sure, will convey their own impressions on the different questions which have been discussed here to the Government of India. Because, whatever be the proposals or schemes suggested, they have more or less to be controlled from the Centre, and as you know, the

States depend upon the Central Government for so many things. Unless there is a common policy for the whole country, taking into consideration the different parts of the country, whatever proposals are put up by us may not be carried out without the necessary backing from the Central Government. But, still the States by themselves can do certain things and they can immediately carry them out, and I think, one of them, is meeting this emergency by means of using more of unfamiliar and subsidiary foods. That is what strikes me as one of the possibilities which can be taken up immediately without awaiting for any large schemes to be carried out. The lady speakers have given us hints that we have to look up to the lady of the house for popularizing the use of non-rationed foods. In the rationing systems and controls, the great pity is that we have to deny sometimes the necessary food for our growing children. We have only half the rations for children below 12 years, but still, as many of you know, some children below 12 eat more than adults. Unless they get some sort of subsidiary or supplementary foods, their health may be shattered and our long-term schemes may not probably find these people living at that time. That is why there was a suggestion made by one of the lady speakers that we must tackle the question of food by catering to our children with tasty and delicious dishes, no matter from whatever material (rationed or non-rationed) the preparations may be.

I feel that one other solution which strikes me is to see how far the subsidiary foods or unfamiliar foods which we are not able to use at present can be made more and more use of so that in the next few months, say twelve months, we may be able to face the food crisis successfully. Fortunately, this year, after four years of failure of the monsoon, there are signs that there is going to be some monsoon. Let us hope that this will come true. As the Hon'ble Shri Munshi has stated, the South-West Monsoon, if it does not come in time, the position after August will be really difficult. We must thank the Central Food Technological Research Institute who has sent out this invitation to all of us. Dr Subrahmanyan should not complain that the response has not been satisfactory. We have all come here because we are anxious to meet

the situation as successfully as possible, and when we go back, after tomorrow's discussions, every one must be able to form his own ideas and if he is in the Government, or connected with the Government of the State or the Centre, he must be able to spread those ideas, or bring them to the attention of the respective Governments as early as possible. At one time, it was suggested that we should make some recommendations to the Governments concerned but I should think that it is not necessary to make a formal recommendation. Here, we are many who are really interested in the question and we have come here for discussing certain matters. It may be that we might not have arrived at definite conclusions but still the general trend of the discussions as also the ideas put forward by different speakers, could and should be summarized and sent to different Governments. I should also, besides thanking the speakers, thank Dr Subrahmanyan for his work on the subsidiary foods and synthetic rice and I suggest that he should continue the work because the subsidiary food element is already catching in several places like Nilgiris and other Estates. In these Estates they are employing a large number of labourers and we are not able to keep these labourers satisfied with the normal rations. Some time ago, the employers were sending me urgent telegrams stating that the whole production would come to a standstill unless the labourers were allotted full quota of grains. But, unfortunately, though we have been able to send their allotted quota of food grains, yet they feel that it is not sufficient, especially when they have to feed the children in their houses also. So, they are now passing orders for synthetic grains in Salem and other places. If necessary encouragement is given and the directions and instructions are issued from an Institute like the one here, I am sure that many people will come forward to take up the production of synthetic grains more and more and naturally the pressure on rice will decrease.

These are some of the ideas which I wanted to emphasize at the close of the session. I have nothing more to add except that time is an important factor and whatever we are able to do we should do as quickly as possible. That will help the situation

far better than merely discussing our long-range schemes. Of course, short-term, middle-term and long-term schemes are also necessary and some of the schemes are being carried out. Apart from this which the Government can do, the public has also to co-operate by taking as much as possible to the use of subsidiary foods to enable the country to get through the next few months successfully: and if we get through the next few months successfully, my hope is that India will get over the crisis. I thank you all once more and especially this Institute and Dr Subrahmanyan for having given me this opportunity to be associated with the Symposium on 'Food and Population'. Thank you.

* * * *

The Proceedings came to a close with a vote of thanks by Dr G. T. Kale.

PART II

SYMPOSIUM ON DEVELOPMENT OF FOOD INDUSTRIES IN INDIA

WELCOME SPEECH

BY

DR V. SUBRAHMANYAN,

(Director, Central Food Technological Research Institute, Mysore)

LADIES AND GENTLEMEN,

Let me begin by extending a hearty welcome and our grateful thanks to the Hon'ble Sri T. Mariappa who has kindly consented to preside over the important deliberations of today. He has done so at very great personal inconvenience. He has practically rushed all the way from Delhi to preside over today's Symposium. I wish to renew our hearty welcome and our warm appreciation of a very friendly cooperation of our colleagues and particularly of the leaders of the Industry who have gathered here today. Most of you have come at a very great personal inconvenience and we are thankful to you for your kind gesture. I do hope that, at today's meeting, some concrete proposals will be made. I also hope that you would offer suggestions as to the ways in which we in this Institute can be of use to the Industry. We have today on the programme a list of some 25 papers. Yesterday, we had difficulty in getting through 15 papers in the scheduled time. Today, we will have to keep ourselves to time and, as a gesture, I am requesting my colleagues in the Institute to stand aside and allow others to read and finish their papers first.

If there is time, we will present our papers. As we had requested yesterday, those of you who are interested in going round our laboratories today, which will be kept open during the interval are most welcome; so, if you kindly come a little earlier after lunch, we would most heartily welcome you to go round the laboratories and see what little we are doing. This evening, at 5.30 p.m., the Hon'ble Sri Mariappa will be At Home at the Government House. We trust that you have all received invitations. If, however, the formal invitation has not reached you, you may kindly take this personal request of mine as an invitation to you. We have made arrangements for transport from this Institute to the Government House.

PRESIDENTIAL ADDRESS

BY

THE HON'BLE SHRI T. MARIAPPA,

(Minister for Home Affairs, Mysore)

Dr Subrahmanyan, Ladies and Gentlemen,

I very much wish that I was present yesterday. Yesterday the subjects were mainly on Food and Population. Today we have to tackle the problem of food industries. These two subjects are indeed very interesting to Food Ministers. The Food Ministry is always worried with regard to procurement and distribution of food grains. After the advent of freedom, India found herself in deficit of food grains. With the difficulties the Central Government had to face as a result of the partition and subsequent development in political field, we had to face an acute food problem—food problem that is indeed a vital problem for the reconstruction of our country. After partition, the fertile lands where more food used to be grown fell to the other side. With the limited resources we had to consume what little food we grew and distribute it to the population. At the very outset, I must make it very clear that the statistics with regard to the growing of food and distribution are very meagre and, I may say, inaccurate to some extent. Nevertheless, with the available statistics, India's food deficit is put at 10 per cent and Mysore's at about 16 per cent. I may not be misunderstood if I place before you the problems of Mysore. Our Head of the Department is also present here, who has to deal with the production of food. Mysore has no doubt all the natural advantages for stepping up food production. But, owing to a century's neglect, neglect of the most criminal kind, we are facing today an acute situation. I think most of you have seen Krishnarajasagara Dam, and Mysore has done pioneering work in the field of building Reservoirs and Tanks. Our ancestors had built about 25,000 tanks for an area of 29,000 sq. miles, *i.e.*, on an average one tank for one square mile. In spite of these facilities, owing to a century's neglect, we have not been able to conserve this national

asset and today we are finding it difficult to feed a population of nearly 90 lakhs. The production in Mysore, in particular areas, is no doubt up to the standard. But there are large tracts in Mysore where the production is not up to the standard and, for the last few years, we have been trying our best to step up production by using fertilizers, preserved compost manure, green manure, restoring tanks, improving river channels and making available the necessary wherewithal for the agriculturist. I think you realize that these problems are indeed baffling, because we have to depend upon millions of human agencies to step up production. Agriculture in our country is no doubt primitive but still we have not disposed of these agencies and switched on to mechanization which may take some years. It is not necessary either to mechanize agriculture in this State or in the rest of India at one stroke. Nevertheless, using the present agencies, in these three years, we have done our best, and, if seasonal conditions are normal, we will be able to cover a large part of our deficit. As I have already said, the deficit in Mysore is 16 per cent. In the last two or three years, we have been able to cover to the extent of one lakh tons of deficit. This year our deficit is of the order of 2 lakh tons. The Government of India have allotted only 75,000 tons and they are finding it difficult to allot the balance of the deficit to this State. Thanks to the magnificent efforts made by the Food Minister of the Central Government, the country has been able to procure and have a steady flow of food and food grains to India. When I was discussing this subject with him day-before-yesterday, he assured me at the meeting that, in the next few months, we would be able to get over the anxious period. We will be able to move food-grains to the parts needing them most, namely, Bihar and Assam, and the particular province of which the Hon'ble Food Minister is here, namely Madras. You might have read his speech in the Press yesterday that the situation should be most carefully considered to tide over the initial difficulty of facing severe famine. Along with the food problems, experts as you are, you must have tackled the problem of population. In Mysore, in the last decade, the population has increased from

73 to 90 lakhs. We have not been able to cope up with the extension of the cultivated land in proportion to the increased population; consequently, we must be satisfied with reduced rations and the loss of nourishing foods. Today, we are dealing with food industries. It is a matter in which the Government of India is vitally interested and Mysore too. Dr Subrahmanyan must have told you the work that is being done in this Institute in regard to the subsidiary foods. He has been assuring us that, given the necessary facilities, the production of subsidiary food industries would go a long way in covering the deficit to a greater extent and providing more nutrition for the people. I am one of those who have faith in what he has been doing in this Institute. It is up to you to find a solution for the several problems that are facing India. The natural resources of the country have not been utilized to the fullest extent and, if these resources are used, I am certain that the difficulties that are facing us would be over in the course of a decade. I presume you are familiar that in 1/3rd of the Mysore State, namely, Malnad, there is great scope for raising subsidiary foods, and fruits, in particular, required for the Canning Industry. I have had discussions with Dr Subrahmanyan with regard to the establishment of a Canning Industry in the Malnad parts of Mysore. There is great scope for raising fruits of various kinds in Malnad areas. Rainfall is plentiful and the soil is very fertile and, if on a planned basis, we can raise fruits, particularly pineapples, jack fruits and other fruits, there is a very great scope for the Fruit Canning Industry in the Malnad parts of Mysore. He has been doing his best to make tapioca popular in Mysore. I may very frankly tell you that people in Mysore have not taken to the cultivation of tapioca in the same manner in which Travancore has done. Since a year, we are trying to push the cultivation of tapioca to some extent, but the results are not very encouraging and yet we have not given up the hope of making it popular in some parts of Mysore.

I do not want to detain you any longer, but would request you to give us constructive proposals—proposals which could be implemented early and bring results soon so that people would

get rid of this difficulty of food problem. It is true that India is labouring under very severe handicaps in the field of starting food industries. They are also facing acute financial crisis and there is also a severe handicap with regard to the establishment of heavy industry. On the 21st and 22nd instants, I had to sit with the Planning Commission with regard to the Planning work in Mysore for the next five years. It will be a surprise to you when I say that the establishment of food industries does not figure in the planning. The Planning Commission's idea is to devote more attention to the basic factors and they may include other industries in the subsidiary plans. At any rate, so far Mysore is concerned, there was no suggestion whatever for either the establishment of food industries or other industries such as biscuits and chocolates or industries connected with food yeast or sugar. Therefore, it is very necessary that these factors will have to be made known to the Central Government and, with their assistance, establish a few industries in places where the soil is congenial and raw materials are available, which would add to the wealth of this country.

Ladies and gentlemen, I thank you once again for having given me an opportunity for associating myself with your work. I am a layman and, as a layman, I am prepared to be guided by the advice of experts. In these days of democracy, it is to the lot of laymen to shape policies and those policies are always founded on well-considered advice given by experts. Therefore, your assistance and experience and knowledge you have gained in various fields must be pooled together and made available to the Government so that we may take guidance and then try to rehabilitate our country. With these few words, I request you now to begin your work.

SURVEY OF FOOD INDUSTRIES IN INDIA

by

N. V. R. Iyengar

(Central Food Technological Research Institute, Mysore)

Food and allied industries in India occupy an important place in our national economy. It has been estimated that about 48 per cent of our national income is being contributed by agriculture and allied industries. These facts are brought out in the paper by discussing the various types of food industries, their magnitude, the capital invested, labour employed and the turnover in each case. The main food industries dealt with are: rice and flour milling, edible oil, sugar, biscuits, confectionary, Vanaspati, dairy, fruit and vegetable canning, cashewnut, aerated water etc. It has been estimated that there are at present 30 types of food industries. Number of large units producing processed foods is over 5,000, with a total invested capital of about 150 crores of rupees. Labour employed exceeds 3 lakhs and the annual turnover 1,500 crores of rupees.

Food and allied industries in India, occupy a very important place in our national economy. Recently, the National Income Committee computed that out of a total national income (turnover of about 8,710 crores in 1948–1949, nearly 4,180 crores of rupees or about 48 per cent were contributed by agriculture and allied industries. Although these figures are not fully revealed by the turnover of the organized factory units in India, it becomes clear when we see that in every town and village, there are innumerable units working to produce food for ready use. Food, produced in the fields, will have to be processed either in small units or in factories. Thus, in every town and village, there are a large number of oil *gunnies, chackies* etc., working on cottage industry scale. Similarly, in a town like Bombay, there are innumerable aerated water units, hotels, wayside tea-shops and canteens. The smaller enterprizes contribute

about 83.6 per cent of the total turnover, while the larger units contribute only 16.4 per cent. On this basis the total capital invested in all these small units may run to hundreds of crores and labour employed may come up to several lakhs.

The food industries in India may be broadly classified into following groups:

(*i*) The basic food industries, comprising of rice milling, flour milling, edible oil industry and sugar and *gur* industry.

(*ii*) Processed food industries such as biscuits and bakery products, confectionary, Vanaspati, meat and fish processing, canning of fruits and vegetables, breakfast foods, dairy products, sago, yeast, cashewnuts, margarine, malt and malt extract, fermentation industries like the breweries and distilleries, infant foods, Bakers' yeast and desiccated coconuts.

We may briefly review the existing position.

I. Basic Food Industries

Rice and flour Milling: India has been producing on an average about 21 million tons of rice and about 6.5 million tons of wheat. Before these cereals reach the consumer, they will have to go through the process of milling. There are about 2,000 mills registered under Factories Act with an invested capital of about 20 crores of rupees engaging about 1 lakh men. The turnover of these mills and also of the very small units is about 1,000 crores of rupees. The present methods of thrashing grains and milling practices call for immediate attention. Thus while thrashing about 2–3 per cent of grains are left in the stalks, and during milling 5–10 per cent is rendered useless. Also there is loss in the storage. This is true in the case of other cereals also.

Edible Oil Industry: Including all the types of edible oils like groundnut, copra, sesame, mustard and cotton seed, India produces about 2 million tons of edible oils worth 400 crores of rupees, against our requirements of 7 million tons. It is estimated that the industry consists of 4 lakh bullock-driven *gunnies*, 1,000 manually operated screw presses, ten thousand power driven rotary

mills, 9,000 expellers and 75 hydraulic presses. The block capita invested in the industry exceeds 12 crores of rupees. The crushing of edible oils is not efficient because 7–10 per cent of oil i left in the cake. Also, there is loss in storage and in transport Thus, the methods of crushing oil seeds require improvement by adopting the latest methods such as solvent extraction process.

Sugar Industry: Sugar industry made rapid progress since 1932. Present production of sugar is about 10 lakh tons valued at 78.4 crores of rupees. There are about 134 factories employing 1,25,000 men and about 3,500 graduates. The capital invested is 40 crores of rupees. The annual requirements of sugar in the country is estimated to be at least 12 lakh tons.

II. Processed Food Industries

Besides these, there are a large number of food industries which use cereals and fats for the manufacture of 'ready to serve' foods. Soon after the war, many of these industries stabilised themselves and we have a large number of processed food industries which meet a good portion of the civilian needs. In 1946, the Government of India appointed 5 industrial planning panels to look into the planning and development of food industries. Since then, food industries have made considerable progress. I will briefly review them here.

Biscuit Industry: The panel recommended a target of 36,000 tons to be reached by 1951–52, which has already been reached. There are 90 biscuit factories including 30 big units. The capital invested in this industry is about 4.5 crores of rupees and the labour is 10–12 thousand men. Owing to the scarcity of wheat flour and sugar and packing materials, present annual production is about 10–12 thousand tons biscuits valued at about one crore of rupees.

Confectionary Industry: The target of production of 55,000 tons fixed by the panel has been reached by the capacity of the existing 56 units. The invested capital of this industry is about 2 crores of rupees and the labour employed is about 8,000 men. Due to the shortage of sugar, the yearly factory production of

confectionery is about 10,000 tons valued at about two crores of rupees. During the year 1948-49, India exported 572 tons of confectionery valued at 11.7 lakhs of rupees. Thus, there is large scope for increasing the export of confectionery. An allied industry which has recently come up is the chocolate and the cocoa powder industry. There is one factory producing chocolates from raw cocoa beans imported from West Africa. The production of this commodity in 1949-50 was about 60 tons. In addition, we are producing large varieties of Indian sweetmeats in all parts of the country and it is not possible to give a correct estimate of their production. However, this industry is using about 80,000 tons sugar annually.

Vanaspati Industry: Refined edible oils are processed to produce the product which is solid at ordinary temperatures and has a longer storage life and which has all its original nutritive properties. In India there are 39 units, with an invested capital of 30 crores and the annual production is about 1,40,000 tons valued at 300 crores of rupees. The industry is giving employment to 25-30 thousand men. An allied industry is the Margarine industry. There is only one unit producing about 800 tons of margarine per year.

Dairy Industries: Shortage of fluid milk has hampered the progress of dairy industries. The estimated annual production of milk ghee and tinned butter is about a lakh of tons and 8,000 tons respectively. There are a large number of ice-cream manufacturing units mostly run by hotels. It is difficult to estimate its production and other details. As regards the milk powder industry, there are only 2 units in the country, both of which are not working owing to the scarcity of fluid milk.

Fruit and Vegetable Industry: The canning industry received great impetus during the war. There are about 300 canning firms of which 100 are working on a manufacturing scale, producing tinned fruits and vegetables, jams and jellies, squashes and cordials. The capital invested in this industry is about a crore of rupees and the labour employed is about 5,000 men. The estimated production of all types of canned products is about

6,000 tons valued at 2 crores of rupees. This industry is enjoying a large measure of protection.

It may be of interest to note that India has been exporting some varieties of chutneys and pickles to foreign countries. In 1949–50, India exported 1,300 tons of pickles and chutneys valued at 19.97 lakhs of rupees.

Cashewnut Industry: Cashewnut industry is the only industry which is a large dollar earner with an annual estimated production of about 55,000 tons. India exported in 1949–50, 18,000 tons of processed cashewnuts valued at 5.3 crores of rupees and there is further scope in this direction.

Among the other industries which deserve mention is the aerated water industry which has made considerable progress during the last 2 or 3 years. There are a large number of aerated water units, the majority running on cottage industry scale. Aerated waters are one of the most commonly used drinks by the public. Many units are modernizing their plants and a firm has recently put up two plants, in Bombay and in Delhi, at a cost of 75 lakhs of rupees. The annual consumption of aerated waters in India is about 770 million bottles.

Tea and Coffee industries have made rapid progress during recent times. India is exporting annually about 4 million pounds of tea and about 4,000 tons of coffee, thus earning a large volume of foreign exchange.

Prohibition in some parts of the country has hampered the potable liquors industry and brewery industry. Annually about 30 million gallons of potable spirits of all types and about 6 million gallons of beer are produced in the country.

There are other important industries although working on a small scale, such as the malt and malt extract industry, sago industry, liquid glucose industry and breakfast food industry. It may be of interest to note that a factory has come up recently in Delhi with a capacity of 5 tons per day for the preparation of breakfast foods such as corn flakes, rolled oats and pearl barley, etc.

During the last year 2 important industries namely bakers' yeast industry and desiccated cocoanut industry have come up. Monthly production of bakers' yeast is about 9,000 lb., while

about 2 tons desiccated cocoanuts are produced and there is scope for further development.

In this brief review it has not been possible to examine the various food industries in detail and I hope the other speakers will cover the relevant points in regard to individual industries. However, the magnitude of the industries in India may be summed up as follows:

There are at present about 30 types of food industries. Number of large units producing processed foods is over 5,000, with a total invested capital of about 150 crores of rupees. Labour employed exceeds 3 lakhs of men and the financial annual turnover is over 1,500 crores of rupees.

PLANNING FOR FOOD INDUSTRIES

by

J. M. Lobo Prabhu, I.C.S.

(*Secretary, Development Department, Government of Madras, Madras*)

Food Industries in India received considerable impetus during the War, and in order to put these food processing industries on a sound footing, Government of India constituted Planning Panels, the recommendations of which have now been sent to all State Governments. The economic justification of food industries is both from the production and distribution sides. Processing aims at utilizing local and seasonal surpluses, such as fruits and vegetables, thus eliminating waste, and also making the raw products attractive and suitable for consumption. The plans drawn up by the Government aimed at the improvement of existing supplies, the extension of factories and at creating new industries. The first two aims were achieved by assisting the existing units by providing controlled materials, priorities for import, export, transport and such other help that the Government could render, and the third aim needs research. The plans finalized by the Government of India require to be implemented; and the Governments of States should take active interest in this connection.

My interest in Food Industries arises from the fact that as Joint Secretary in the Food Ministry of the Government of India I saw the greatest growth of food processing during the war. I also saw the liquidation of many food industries, to arrest which, during the Ministership of the Hon'ble Dr Rajendra Prasad, I was charged to prepare plans. Six planning panels were appointed for which I drew up 24 plans. After I left the Ministry, the subject was transferred to the Ministry of Industries and Supplies, which after a long time, issued the plans, now available to all State Governments. The idea of the Food Technical Institute was

also born at the same time and I am proud that it has found its form in this Institute.

The question may well be asked what have the plans and the Institute done for food industries. When the plans and Institute were conceived in 1946, everyone expected a period of plenty, of deflation and a buyer's market. The problem was largely regarded, as one of saving the industries, which had grown up during the War, from competition among themselves and from foreign imports. The problem was also conceived as one of conserving food for which there was no immediate use and of providing supplements of fortified diets to the ordinary food of the people. The subsequent economic history falsified these assumptions. Food shortage continued and was, in fact, intensified, so that there was little or no food available for conservation. Prices instead of going down rose up phenomenally so that machinery and structural material required for establishing or extending new industries became difficult to procure. Shortages and relatively higher prices of raw materials similarly deterred expansion. At the same time the collapse of the share market and the consequent financial stringency prohibited investment. The only saving factor was that difficulties of foreign exchange limited imports, and secured a natural protection to established industries which has enabled them to survive. Food industries, like many others, are therefore existing on the momentum gained during the War, a situation, by no means satisfactory and one which this Symposium may well consider.

The economic justification of Food Industries is both from the production and distribution sides. From the production side, processing aims first at utilizing local and seasonal surpluses. There is a large variety of fruits, vegetables, crops and by-products, which are not locally saleable, either because they have glut periods, or because they occur far from the centres of consumption. The conservation of such surpluses not only eliminates waste, but by providing good prices, encourages production. A second reason, on the side of production is that there are many products, which in their natural condition are not attractive or suitable for consumption, without some form of processing. There

are some other products, the nutritive value of which can be increased by fortification and other allied processes. All in all, processing aims at applying Science, which is the mark of civilization, to products in a natural state, which receive thereby a higher nutritive and commercial value.

On the distribution side, the war taught the population, the value of canned products. The portability, readiness, and even the taste of processed foods came to be generally appreciated. One other fact, the hygienic condition also appears to have become apparent in processed foods, which, in the prevailing market condition, was tending to be absent in unprocessed supplies.

The general strategy for the Food Plans drawn up in 1947 aimed first at improvement of existing supplies; secondly, at their extension; and thirdly, at the creation of new industries. The necessity for improvement was vividly evident from the difference between local and foreign production. The local production, which suffered from lack of standardization, was generally inferior, and in some instances deceptive. No assured market could be built up except on uniform quality. Accordingly the plans conceived approaches from three different salients, first that Government may lay down standards, analyse supplies, and certify products produced under approved conditions. The second approach was through organizations of the industries concerned themselves, which undertook to enforce standards and maintain the appropriate discipline. Such Associations were to be recognized as channels for distribution of controlled raw and structural materials, priorities for import-export and transport and for all other help which Government could render. The underlying idea was that when these industries depended on government for their existence, that dependence should be exploited to introduce changes essential in the interest of the industries themselves, and of the general consumers. The third approach was through the consumers, who were to be educated into a proper appreciation of the indigenous production.

In respect of the second aim, that of extension, the plans related to the production and consumption of the different areas of the country, to prevent the haphazard growth which had been

taking place without due reference to the sources of raw material and of the markets. The plan was to be enforced by licensing ultimately and immediately by refusing help for construction, not authorized.

The third aim involved some research; to find out what material was available and how it could be best processed. The plans revealed that much raw material was wasted and some was not put to the best use. Specially in respect of animal by-products, private enterprise was either ignorant or reluctant. The plans were meant to indicate the outlines of schemes and their cost. There was a proposal to subsidize some of the schemes, and to protect others from foreign competition. The production of vitamins, particularly of food yeast for which a factory was sanctioned was closely examined. Similarly in Bangalore, Dr Subrahmanyan was encouraged to proceed with his experiments on soya bean products.

The question before this Conference is, what should now be done for Food Industries. First and foremost, this Institute may not only undertake research but make its results popularly available. It may be possible to publish plans for a variety of industries, giving details of the raw materials available, the appropriate processes, the machinery required and its approximate cost, and the nature and size of the market. If the economics of such projects are vouched by the Institute, State Governments will be ready to finance and even subsidize them.

The next step is to implement the plans already published by the Government of India. So far, it does not appear that these plans have received sufficient publicity. But that alone is not enough. There should be a definite State policy to restrict government help only to those industries, which accept the discipline necessary. For instance, there should be no allocations of sugar, flour, tin plate, structural material, to factories which do not standardize their production according to prescribed specifications. It is true that anything sells today due to the absence of foreign imports. This is more reason that what is sold is reasonably good. In the existing shortage of raw materials, there is also reason for the best use being made of them.

There is a great future for Food Industries, but it is necessary to organize for it. Too long have we left private enterprize without control and guidance. This symposium may inaugurate a new order of co-operation among the industries for carrying out a common policy of improvement, for their own benefit and that of the consumers.

THE URGENT NEED FOR DEVELOPING THE FOOD INDUSTRY IN INDIA

by

Luis Jose de Souza Importance

(*Messrs. Food Preservers, Ltd., Bombay*)

The development of the Food Preservation Industry in India is URGENT *as it is both* ESSENTIAL *and* STRATEGIC. *In the present food crisis it can play an important part. Without providing the means of preserving what little we already produce, the campaign of Grow More Food is like an invitation to 'Waste More'. If the question of Food is to be solved on a war footing, the Industry cannot be left out of planning for food. The importance of the Industry was demonstrated during the last World War. Even during the peace period the Government of India buys over 3,000 tons of canned foods for the Armed Forces.*

The Indian Food Preservation Industry should be one of the so-called 'regulated' industries. The Government can then control the prices, keeping them within the reach of the low-income group of consumers. This means the Industry must be subsidized. In other parts of the world, where the Industry is recognized as an essential industry, subsidies, direct and indirect are being given. The Government of India is spending large sums of money on imports of cereals. Subsidies should be given to increase the supplies of locally grown foods. The Preservation Industry can bring about increased production; because, it can offer the grower a ready market and a fair price for his produce. The Canner can eliminate gluts and thus save the colossal waste that now occurs during the glut periods. It is therefore imperative that the Government should take immediate steps to develop the Preservation Industry in the country as a part and parcel of its Grow More Food Campaign. Let the Grow More Food Campaign include the Industry in its programme, and the results will be beneficial to the country.

That in this second half of the 20th century, a period of intense scientific development, one should be posing the question whether the Food Industry should or should not be established and developed in India is nothing short of a confession of one's ignorance as to the importance of the industry and the progress made in this field in other parts of the civilized world.

We who produced the finest muslins when in Europe they still prized the traditional fig-leaf, we who introduced the world to the enticing flavours of the various spices, in short, we who led the world in almost every walk of life not so long ago, are today floundering in the jungles of ignorance created by a sense of perverted moral values.

In our search for the Nirvana, we are losing sight of the things that matter right here and now; the things the man in the street is deeply concerned with. But, I am not going to take your precious time in listing here our numerous sins of omission and commission. What I am concerned with today is the topic that is uppermost in the minds of all, namely Food.

We all know that India today is facing a grave crisis on the Food Front. Famine conditions are already prevailing in some parts of the country. What is the help we, Food Technologists, can offer to the Government in overcoming or at least minimizing the danger threatening the very existence of the nation?

Undoubtedly, the present serious situation is due partly to natural calamities. But it is mostly due to our muddled thinking. Consider for a moment the veritable barrage of plans for making India self-sufficient in Food. The very first thing that we notice is that the connotation of the word 'Food' is so circumscribed as to mean only cereals, and cereals alone. The protective and subsidiary foods do not appear to exist so far as our food planners are concerned. Bananas and sweet potato appear to have come on the scene as an after-thought.

The next thing we notice is the absence, almost total, of the word 'preservation'. And this in a country which is mainly agricultural, and where crop failures are endemic, and famines chronic in their recurrence. How it is possible to increase production without providing the means to preserve what is

produced is something that ordinary people like me cannot understand.

Working on the basis of such false premises what conclusions can one arrive at? The remedies suggested to fight the situation are the result of this muddled thinking: If you cannot get rice, eat milo; and if you do not like milo or barley, eat vegetables, which are not available or, if available, are so expensive that the masses cannot afford them. The best remedy, however, is that you Miss-a-Meal, or do not eat at all!

I do not think that it is necessary to point out that the false meaning given to the word Food calls for urgent and immediate change. The sooner we broaden the meaning to include all the products, vegetarian and non-vegetarian, that go into the human dietary, the quicker shall we be able to solve our food problem.

It would be superfluous on my part to dwell on the history of the development of the Food Preservation Industry at a gathering like this. The need of preserving food was first felt under the stress of war. The problem of supplying the constantly moving armies over long distances from the main supply bases led Napoleon to invite food suppliers to devise ways and means of preserving foods over long periods. Appert was the pioneer that laid the foundations of what today is one of the great industries in the world. But it was not until Pasteur came into the field that the principles of preservation were placed on a scientific footing. Since Pasteur's discovery of preservation by the application of heat gigantic strides have been made in the modes and techniques of preservation.

You all know of the colossal scale on which canning is today done in other parts of the world, particularly in the U.S.A., where the food preservation industry is a *major* industry. To give you an idea of the production of canned foods in America allow me to mention just one Cannery: the Sunnyvale Plant of M/s Libby, McNeill and Libby, where I worked for some time. At that time, 25 years ago, its output was 2½ lakhs lb. per day; today it is 10 lakhs lb. per day. . . . Here is something that should interest our food planners.

The development of the Food Industry all over the world,

including Australia and even Africa, receives constant attention from their respective Governments. And this is so because the Industry is considered as an indispensable ally of the horticulturist, the stock farmer, the poultry breeder, and the fisherman alike. And this is as it should be, because nothing can help the grower more or better than the Canning Industry. The Canner and the Grower work in co-operation, aided and supported by the Government.

We have all heard of and read about the Grow More Food Campaign. And we have read and heard even more about its abject failure according to some, and a resounding success according to a few. It is not my business to analyse the pros and cons of this controversy. But I am going to make this emphatic statement: We shall never succeed in increasing production unless and until we provide the means of preserving what we grow.

It is common knowledge that at present there is a colossal wastage in what little we do produce. During the fruit and vegetable seasons the wastage is 25 per cent, and in some cases as high as 50 per cent. A similar wastage occurs in the fishing industry also. How can this wastage be prevented except by preserving what now goes to waste? Cold Storage is just at the moment in fashion. But I make bold to say that this mode of preservation cannot solve our problem. In a country like ours, of immense distances and a very reduced buying power, frozen foods will take a very long time to reach the masses. Canned foods can become popular as we shall see.

Canning, therefore, is to my mind, the obvious solution. No amount of subsidies or loans will lead the grower to increase his production. What he demands, and rightly so, is a market and a fair price. A ready market for his produce and a fair price for the same. Need I emphasize that only the Food Preservation Industry can offer these facilities to him? And let me say that given these he will need no coaxing to increase his production.

And yet there are officials, who have actually reported that the Food Industry deserves no consideration because there is neither fruit nor vegetables nor fish to can. And this despite

the fact that the percentage of wastage I have just mentioned is taken from official documents. It is equally official when I say that over 38 per cent of the fish catches are turned into manure, and therefore is definitely a wastage of food.

Another equally amusing argument put forth is that canning is likely to produce a shortage of fruits and vegetables in the fresh produce markets. I called this amusing, but I think it would be proper to say that it is tragic. Anyone who has studied the subject can tell you that first, the canner makes his bulk purchases only during the glut periods, thus saving a lot of wastage that would otherwise occur and thus definitely contributes towards maintaining a fair level of prices. Secondly, when the demand of the canner becomes known to the grower, it will act as a powerful incentive for him to increase his production. I can cite dozens of cases where the grower has been saved from ruin by the demand of the canneries.

May I be permited to cite another little example to illustrate my point. When the Fisheries Department of the Government of Bombay started extracting shark liver oil, it could not get a sufficient or regular supply of shark livers. But as the demand became known within the short period of six or eight months more than half a dozen fishermen actually specialized in the catching of sharks, and the Government Laboratory now gets more livers than it can handle. Now I ask, who coaxed these men to land more sharks? Was it not a market and a price offered by the Government Laboratory?

The huge and scientifically planned Californian fruit orchards and vegetable growing farms were developed to feed the canneries. Similarly the Australian fruit production and vegetable growing grew with the development of the Australian canning industry. The interdependence between these two is so close that any adverse factors affecting the one affect also the other. It is for this reason that the Governments in other countries not merely keep a watchful eye on them both, but also help them both by constant technical assistance and material help wherever and whenever necessary.

We all know how the Australian Industry was assured the

supply of sugar at the lowest world parity price. We know also how the American Government subsidizes the farmer to secure for him a ceiling price, by enabling the Canneries to purchase the fruit and vegetables at a low rate. A further help is extended to the canneries by placing large orders for particular products and then distributing the products to the school-going children as a part of the Free Lunch Programme. As a contrast we in India not only refuse to lend any material help to the industry, but refuse even to consider it as an Industry.

Doubts are often expressed as to whether canned foods will ever become popular in India. The last World War made millions of people familiar with canned foods. The absorption of crores worth of Disposal Goods proves that canned goods are in demand, and that the demand has come to stay. If further proof were needed we have the clamour against the restricted imports of canned foods. And let it not be forgotten that the canned vegetables and particularly fish and meat products are prepared for foreign taste. Let the Indian canner supply canned foods prepared in Indian style, and one need not be a prophet to visualize the increase in demand that must take place.

The one factor that today restricts the consumption of canned foods in the country is their high price. The reasons for this are many and varied: the high price of empty containers whether of tin or glass, the abnormally high price of sugar, the unreasonably high transport costs, the inefficiency of labour, and other factors contribute towards the high cost of production. It is to overcome these difficulties that the Industry has time and again appealed to the Government to come to its rescue. Exemption of duty on machinery, the supply of tinplate and sugar at reduced rates, the lowering of transport costs, for the transport of raw materials from the centres of production to the factories and of the finished goods from the factories to the centres of consumption were some of the steps that the Government can and should take immediately to help the industry.

The Indian Food Industry is perhaps the only industry in the country that volunteered to be taxed to enable the Government to exercise a certain amount of control during the initial stages.

It went further and agreed to have the tax raised from Re 0.25 per cent to Re 1 per cent. And though this increase was to be utilized for establishing testing and research laboratories to help the industry, the tax continues to be collected by the Government, but the promised technical help is nowhere in sight. On the contrary, the administration of the patchy Fruit Control Order has now been passed on to the States, with the result that, at present, confusion reigns supreme, each State acting as it thinks fit, or sometimes not acting at all!

When the Industry asked to be allowed to import only 5,000 tons of sugar for canning surplus fruit, it was told that it was unpatriotic to import sugar, when we had a protected sugar industry. One wonders how and when it became highly patriotic to import 1 lakh tons of sugar at almost double the price at which the Industry proposed to import it. Again, when the Industry literally begged to be allowed to import only 500 tons of tin-plate, the hackneyed argument of shortage of foreign exchange was trotted out. But almost in the same breath licences were issued for the import of huge quantities of canned foods, in spite of the fact that the canning industry was also a protected industry like the sugar industry. Yes, there was no exchange for importing empty tins, but there was a surfeit of exchange for importing filled tins. This is certainly Swaraj, with a vengeance!

The attitude of the Government towards this important industry is more than paradoxical. On the one hand, we have tariff protection, grudgingly though it may be, courses in food preservation, and last but not least, the Central Food Technological Research Institute. On the other hand, we have officials ostensibly appointed to help the industry, advising the canneries to convert themselves into bangle manufacturing plants; we have others calling the industry not food industry, but *fraud industry;* yet others hoping that the canning industry deserves no consideration at all because there is no fruit, or vegetables or fish to can. What a wonderful situation for the industry to work in, if to work it is allowed!

One need not be an economist to state that the Food Preservation Industry is of national concern, and therefore it must be

centrally helped and centrally controlled. Problems like that of customs tariffs, import permits, railway freights, cannot be dealt with by the States. They must be attended to by the Centre. But our financial pundits in Delhi decided that there were no funds to maintain a department at the Centre to help and guide the Industry, and lo! the whole thing is thrown to the States—something that will make others have a good laugh at our cost.

It may interest you to know that despite the hundred and one handicaps under which the industry labours, it continues to make progress. During the year 1950 the industry produced fruit and vegetable products worth well over a crore of rupees. This included 77 lakhs lb. of vegetables, 44 lakhs lb. of jams; 34 lakhs lb. of fruits in syrup; and over 5 lakhs gallons of fruit juice squashes. This does not include the *morabbas*, the crystallized fruits, *chutneys* and pickles, all export items worth lakhs of rupees. And yet the industry does not even deserve to be classed as an Industry!

I must admit that though technically the Industry has made great strides during the last year or two there is plenty of room for improvement. We hear a lot about the low quality of Indian canned foods. But can anyone tell me that first-grade products can be manufactured out of third-rate raw materials? The Industry has placed its difficulties in this connection before the authorities concerned, but so far with no results. Let the Government help the horticulturist to improve the quality of his produce and the canner will automatically give you better quality.

In this regard, I must state that not all complaints about the quality of Indian products are admissible. In 80 per cent cases, it is mere fashion to deprecate your own and praise the foreign. To demand perfection in the Food Industry, an industry which is yet in its incipient stages, is to cry for the moon. And in what industry has perfection been attained, may one ask? I do not defend the unscrupulous manufacturer who has an eye only on the profit side of his business. There are undoubtedly some amongst us who deserve to be pulled up. But to generalize something that applies to a very limited group or section is

neither just nor sensible. Were all the products as bad as they are made out to be, the Government, the largest single buyer of Indian canned goods, would not have patronized the industry. Government purchases for the armed forces run into several lakhs of rupees, and on the testimony of the Food Department officials concerned the quality has been satisfactory.

The question of price has already been mentioned above. The Industry has time and again pressed its claim for a subsidy from the Government to enable it to sell cheaply. But the very mention of the word subsidy seems to frighten our financial Pundits. Crores of rupees are today spent in subsidizing the import and sale of cereals, some which are feed for pigs and fodder for horses in the exporting countries. Lakhs of rupees are spent in the fantastic Grow More Food Campaign. But an Industry which proposes to preserve what is grown is not contemplated in this festival of so-called planning.

By subsidizing the sale of imported cereals are we not indirectly subsidizing the American and Australian and Argentinian farmer? Why, then, the hesitation to subsidize the Indian fruit and vegetable grower? Perhaps because fruit and vegetables are not food? The Industry does not insist on the form of the subsidy which may be given to the farmer. It may take the shape of purchases on Government account for free distribution below cost prices. The point is to enable the industry to place the foods within the reach of the average consumer. And that this request is not a novel or extraordinary one has been demonstrated above. Subsidies are given not merely to lower the prices in the manufacturing countries, but even to facilitate export.

The question of subsidies would have assumed a different meaning if the Industry were considered as an essential industry. In other countries, the industry occupies an important place in the economy of the country. But here, the industry is still in the regions of a luxury industry, and hence the refusal to consider this all important question of building up the industry. The Food Industry is a MUST industry, and the sooner the Government change their attitude towards the industry, the better will it be for the country. For self-sufficiency in food does not and cannot

mean a mere increase in production. It also means the conservation of what we grow and, above all, its *preservation.*

To ask the people to *grow more* without providing the means for preserving what we grow is more like an invitation to *waste more.* A fully developed Food Industry can not only save the colossal wastage that now occurs, but provide those factors which the grower requires to lead him to grow more, namely a ready market and a fair price. This applies equally to the fruit and vegetable grower, the stock farmer, the poultry breeder and the fisherman.

It may come as a surprise to many that over 85 per cent of India's population is non-vegetarian. This being the case, it is easy to see the importance of fish and meat products in planning for food. India with its thousands of miles of coast line can certainly produce immense quantities of fish, not to speak of the riverine fish that can be obtained, and fish is a valuable food, rich in nutritive value. Efforts are being made to develop the fishing industry. But, here again, we find no mention of the Preservation Industry. Only ice-factories and cold-storage plants are thought of. But, as you all know, cold-storage preservation is the costliest method of preservation.

Canning is the one method whereby this valuable food can be easily and economically preserved and distributed all over the country throughout the year. The development of the food industry is therefore an urgent matter which deserves priority. The Food Industry will not merely preserve what now goes to waste, but will contribute materially and effectively towards an increase in production. The Food Industry does something more: it converts many a product that is generally not consumed as food, and improves others. The enriching or fortifying of foods is a part of the Food Industry. The conversion of what are considered waste materials into edible and palatable products for human consumption is another part of the Food Industry.

I think I have said enough to demonstrate the need of developing our Food Industry as a part and parcel of our Planning for Food. The development of the Food Industry in the country is a *sine qua non* for the success of the fight against the chronic

food shortages and the endemic famine conditions in the country. The Central Food Technological Research Institute has a part to play in this development and I am sure it will not be wanting, provided, and it is an important provison, the Government help in translating the results of research into useful aids in our search for food.

FRUIT AND VEGETABLE PRESERVATION INDUSTRY IN INDIA

by

H. C. Bhatnagar

In order to develop the fruit and vegetable preservation industry in India, which made a beginning during recent times, it is necessary that various aspects of the Industry such as cost and production, unit operations and processes, and time and motion should be carefully studied. Further, since the tastes and food habits vary in different parts of India, research on food acceptance requires to be done before any product is put on the market. Thus, there is need to establish a group-research to evolve the food acceptance of different classes of products. For this purpose, the factories in several regions should come together and carry out tests by planning statistical analysis for the market acceptance which could be judged by a panel of experts drawn from the trade and the public. This will bring the consumer and the producer nearer than at present.

It was only in recent years that large-scale manufacture of fruit and vegetable products was taken up on scientific lines. Otherwise fruit preservation in the form of manufacturing chutneys, pickles and *murabbas* was being practised in this country from time immemorial. A few firms in the provinces of Bombay, Bengal, Madras and the Punjab were engaged in this industry in the pre-war period and the majority of them manufactured fruit beverages only. During the war also this industry could not progress well. Large-scale dumping of American canned food surpluses in the market did slow down the progress of this industry temporarily, but heavy restriction on imports after the war and the increased demand of preserved fruits and vegetables in various forms for the Defence Services and Civilian trade gave a stimulus to this industry.

Many squash and canning factories sprung up all over the

country and during the year 1950 over 7,800 tons of various fruit products were manufactured.

Canned fruit ...	...	1,500 tons
Jams, jellies, etc. ...	...	1,800 ,,
Squashes and Cordials	...	2,100 ,,
Other fruit products	...	2,400 ,,
		7,800 ,,

The industry has also been meeting the entire requirements of the Defence Services with respect to fruit and vegetable products since 1949.

In the year 1945, the Government of India recognized the importance of this industry and established a Fruit Development Office in Delhi. At the request of the Industry, the Fruit Products Order was promulgated in 1946 in order to ensure that the fruit products manufactured in the country conform to certain minimum standards regarding quality and hygienic conditions prescribed. The Industry pays a cess of Re 1 for Rs 100 worth of production, for its development.

It has been enjoying protection of high duty on imports for the last four years. All these factors have contributed to the steady progress of the industry.

Cost and Production

There are various angles from which the problem of 'Cost and Production' has to be viewed. For Indian conditions, the standard methods of cost accounting and the particular relationship of each factor have to be examined with a full understanding of the problems confronting the industry. Again, there is a special interest in considering this subject at this Symposium as this assembly consists of many academic workers and others doing industrial research.

Unit Operations and Processes

When the laboratory technique is transferred to the pilot plant and from there to the factory scale, slowly the processes divide

themselves into unit processes. In India, we have not yet reached such a stage in this industry as to classify the operations into different units, but for the matter of analysis of the working, classification is inevitable. In a processing plant the following classification would enable us to analyse the work.

(1) Conveying: Hand operators, belt conveyers, apron conveyers, open link conveyers, screw conveyers, bucket and freight elevators. Some of these conveyers are in use, but the conveyer system is not well exploited because of cheap labour and many times due to the resistance of the workers and technicians to adopt anything new. Factory experience shows that when large quantities are to be handled, the percentage cost of the labour bill for conveying the goods runs as high as 50 per cent (Mangoes). For liquids, the gravity flow and the pumps are universal, but here also sometimes the industry is rather shy to introduce these simple devices, which may indeed cost much in the initial stages.

(2) Weighing: This is a vital step in the production which affects the efficiency indirectly and sometimes the lapses here may prove very fatal. There is no standard packaging for the raw materials and different fruits come in different size baskets having varying loads. Sometimes, the weight of the packing material which is being transported with the raw materials is much too high to be economical. Some type of standard should be fixed and standard crates for fruits should be defined. Again the rates quoted in the markets are for baskets of four dozens or maunds which vary from 28 lb. to 82 lb. per maund. The problem of grading would remain unsolved until the Government takes some firm measure regarding the matter. The malpractices of the trade must be stopped; otherwise, the ever-formidable task of quality control would remain unsolved.

(3) Disintegration: Peeling, slicing, pulping, snipping, shredding, crushing, shelling, etc. The processes are quite well-known and many factories have mechanized some of these processes. Manual labour still remains our main-stay and, before judging this question, it is better to note that in some of these operations the manual labour saves wastage, *e.g.*, peeling losses in potatoes are 15–25 per cent as compared with 30–35 per cent

when abrasive peelers with force spray is employed. The yield in pine-apple is higher because the eradication is more thorough when done manually.

Heat Treatment: The problem of heat treatment is rather a complicated matter and the existing systems are far from satisfactory. The processing times employed are based on experience and the so-called judgement and not on any sound research. Here is a field where this Institute has to play the major role while the factories would only play the minor one. Most of the products marketed in India are over-processed, to be on the safer side. Of course, there are certain factors like the hygienic conditions of the factory and the micro-biology of raw materials and the weather conditions during the period of storage with special reference to thermophylic organisms have to be considered before arriving at definite conclusions. Less tax on the boiler is needed during the rush hours and, if the processing is done at the right time and temperature, this will be a great help in increasing the production. Having reduced the time for processing potatoes from 70 minutes to 50 minutes at 240°F, the late processing hours in the factory were considerably reduced. Work should also proceed to introduce agitating cookers and the horizontal type of retorts. There should be special reference on the saving of time and more particularly the load on the boiler which would pay more than enough dividends.

Cooling: When the supply of water is inadequate, cooling is a very difficult problem. Recirculation of cooling water after passing over the cooling tower or storing the water in the fountain helps. Use of ice is rather a costly proposition. We may use fine spray on the tins, which would give vapourizing effect. Cooling by vapourization is an efficient method because of the latent heat required for vapourization.

Time and Motion Study: The research in this field is made applicable to big industries. A wide application of this research can be useful where most of the processes are manual. In one of our studies handling of forceps in de-seeding oranges played an important part in the output. If the output of individual

is checked for similar work and the reasons ascertained for inefficient work, the production incentive can be enthused.

The man-hour output is another index to judge the efficiency of any unit. It is a matter of regret that the efficiency of Indian labour has been on the decline in spite of higher earnings in some industries. The nature of work is ever changing in a food factory and the rate of work cannot be the same for individual product. The variation in the production per man-hour is 6–18 pounds. Quality control and time and motion study work should be taken up as a subject for research and, for the benefit of the industry, the C.F.T.R.I. may consider including this work in its programme.

The second phase of cost and production, the percentage of yield for different fruits and vegetables will be of great interest.

Each fruit has to be considered from the specific problems it presents. For reference and study of comparative costs the following table gives distribution of cost under various heads.

	Pine-apple slices percentage cost	*Mango slices percentage cost*	*Apricot jam percentage cost*		*Squash percentage cost*
Fruit	34	40	15	5 (pectin)	18
Sugar	7	7	29		19
Labour Indirect ...	5	4	7		7
Indirect expenses	7	5	5		8
Cans or bottles	12	12	14		13
Case	5	5	5		5
Labels	2	2	2		5
Spoilage ...	3	3	2		2
Freight	6	6	6		8
Sales and returns	19	16	10		17
	100	100	100		100

Average percentage of incidence of cost to the consumer:

Fruits	30%	37%
Sugar	7%	
Container	13%	20½%
Labels	2½%	
Packing	5%	
Labour and overhead ...	12½%	
Spoilage	2½%	
Freight	5%	
Sales publicity ...	15%	
Returns ...	rest	
	100	

Food Acceptance Research

The research in food acceptance aims at the co-ordination and building up of relationship between producers and consumers. Acceptance factor has much wider meaning for the Indian producer. The commercial products have to break through the walls of family traditions and the customs of each State. The family taste panel passes judgment on all aspects of taste, palatability, function of combination, the manner and mode of preparation, and last but not least, the factor of cost.

However high in nutrition, each food has to be judged from what it gives to the consumer; there is a connecting link between the living subject and the food he lives on. This link is the acceptability.

Taste for Canned Fruits and Vegetables

The resistance to the acceptance of canned fruits and particularly of vegetables comes mainly from the food habits of people. Apart from the price level resistance, the people have not developed taste and actually have unsympathetic attitude to canned foods. This needs education, and cultivation of the confidence of the public. To quote an example, pine-apples have been easier to market as the public was accustomed to canned pine-apples in

pre-war days. Again, fruits like peaches have little market resistance while guavas and papayas have not been favoured much, because the former have been widely used in other countries.

We are at the beginning of an up-hill road which we have yet to climb. For future trends we have one factor in favour. Generally, malnutrition creates response to various nutrients, and sugar solutions, glucose and certain minerals have proved to be more acceptable when the deficiencies exist. This gives us hope that when the price level of food levels with less-income groups, Nature would help us.

Traditions of house are more governed by the housewife. In orthodox homes, the acceptability of canned vegetables would be a difficult proposition. Middle-class families are far from being well off these days and more women are taking to education and becoming earning members of the family. Consequently, the market of canned provisions is expanding and more and more of the middle-class families are accepting canned foods first as a luxury and then as a necessity.

Curried Vegetables

Our food pattern is most varied, and I venture to add, more heterogeneous than anywhere else in the world. Striking are the variations in the preparation of vegetables, variations in all aspects of the preparation, such as the oil, the spices, the amount of water, the combinations of vegetables employed, etc.

Conclusions

There is need to establish group research to evolve the food acceptance of different classes of products. In each region, local factories should come together and carry out tests by planning statistical analysis for the market acceptance which could be judged by a panel of judges drawn from local people in the trade as well as consumers. This is to bring the consumer as near the producer as possible and make their relations more amicable and increase confidence in each other.

This has already been initiated in Bombay.

In

THE FUNDAMENTAL IMPORTANCE OF THE SUGAR INDUSTRY IN RELATION TO THE DEVELOPMENT OF FOOD INDUSTRIES

by

N. A. Parkes

(*Messrs. Parry & Co., Ltd.; Madras*)

The expansion and development of sugar industry on sound and economic lines is of fundamental importance for both increasing the available sugar resources in the country and helping the development of allied food industries such as confectionery, condensed milk, jam, fruit canning etc., which depend on pure sugar. Thus, the first problem is to increase the production of sugar to a level in excess of the normal demands for use of sugar as such, thus giving a surplus for absorption by food industries. In this direction, the Government have given various incentives to growers and sugar manufacturers. The growers will have to adopt such measures as practised in West Indies, Jamaica and Dominican Republic where the sugarcane yields a very high percentage of crystallizable sugar. As regards the confectionery industry, sugar being the raw material, all the other essential products such as corn syrup, gelatine, fruit pulps, essences and food colours are all imported. As regards packing material, except for fancy cellophane paper and metal foil paper, the rest are made in India. On account of the scarcity of the essential raw materials in many instances, inferior products are produced. The paper suggests, therefore, the establishment of indigenous industries designed to produce the various raw materials to meet the demands of manufacturers. In order that the industry may develop on sound and scientific lines, it is necessary that there should be rigorous control regarding quality of the products produced and also quality of the raw materials used in the industry. The Government should enact standards of purity and quality for these products.

Dealing with the production of food yeast in India, the paper briefly describes the use of food yeast in various forms and also its nutritive value and the need for popularizing the product. Manufacture of baker's yeast is of recent origin and it is finding a wide market in India. The factory, at present, produces Pressed Yeast and, consequently, is facing the difficulties as regards the transport of this material to various parts of the country, for which they use cold storage methods. The factory is attempting to produce dried baker's yeast and they hope to succeed in this direction.

THE potential production of sugar is so vast in relation to the demands of the normal householder that it must be regarded as an Industrial Resource of the first importance. Nevertheless it is a raw material that has been relatively very little exploited in fields other than those utilizing sugar as a direct food in the familiar form of 'Sugar and Sweetmeats'. Apart from these unexplored fields we have many food industries in active production which depend on the availability of sugar in its present form for their very existence.

The expansion and development of the Sugar Industry on sound and economic lines is therefore fundamental to the expansion and development of the allied food industries of confectionery, condensed milk, jam, fruit cannery and a host of other preserved foods which depend on pure sugar as their preserving agent.

Our first problem is, therefore, to increase sugar production to a level in excess of normal demands for culinary purposes, thus giving a surplus for absorption by food industries. Sugar is and must be looked upon as a food of the highest biological value and as such its essential inclusion in the priority list of food-stuffs is second only to basic food-grains.

Various incentives have been, and are being, given by the Union Government to encourage both growers of sugarcane and manufacturers of sugar to increase production. On the manufacturing side, the majority of sugar factories are well equipped and managed by experienced technical personnel, which has

resulted in a manufacturing efficiency comparable with any other sugar producers in the world. I have recently returned from a tour of sugar factories in the West Indies, including Trinidad, Jamaica and the Dominican Republic. As a result of my observations I am convinced that we must turn to the agriculturist for that increase in the production of sugar in India which will leave a surplus for the expansion of food industries requiring pure sugar. Sugar is made in the fields not in the factory. Our factories are mostly capable of producing more sugar with their existing equipment provided improved cane quality is obtained without reducing the tonnage of cane per acre, a difficult proposition as quality and quantity rarely coincide. With sugar freely available at a reasonable price, the development of the various food industries can proceed unhindered by serious handicaps such as now face the manufacture of any product containing sugar. Capital is naturally shy when the raw materials necessary for the industry in question cannot be readily obtained. The raw materials for the sugar industry are indigenous and it only remains for the growers to produce more sugar per acre from the available lands to meet the basic demand for sugar and leave a surplus for the development of food industries.

Confectionery Manufacture: The position with regard to the expansion of the manufacture of confectionery is not only governed by the availability of sugar, but also by other essential products such as corn syrup, gelatine, fruit pulps, essences of high quality and harmless food colouring materials. Most, if not all, of these ingredients are at present imported into India. Apart from the essential ingredients large quantities of packing materials, tins, paper and packing cases are required, these latter materials with the exception of fancy cellophane and metal foil papers, are available and made in India but are in exceedingly short supply.

The general situation leads existing manufacturers to seek substitutes for the ingredients in short supply, with the result that in many instances an inferior product is produced which, when marketed, is immediately branded by a discriminating public as 'not as good as imported'.

The slogan for all food product industries should be:

Nothing but the Best is Good Enough.

This applies to all ingredients and raw materials. An alternative ingredient may often be used with success but a substitute can rarely be considered as a satisfactory equivalent.

The second problem, as I see it, is that of creating new indigenous industries designed to meet the various demands of food product manufacturers, *e.g.*,

(*a*) 'Corn Syrup' (glucose) of a quality equal to that of the world famous Corn Products Ltd.
(*b*) Citric and tartaric acid manufacture.
(*c*) Essences and essential oils for flavouring purposes.
(*d*) Edible gelatine.
(*e*) Packing materials of all descriptions.

The list covers but a few of the main necessities which at present limit any expansion programme.

Similar conditions exist in other food industries such as the manufacture of biscuits, jam, and natural fruit cordials and canning. Mostly, existing manufacturers are limited only by the supply of raw materials and their factories are working much below rated capacity on this account. Manufacturing costs are consequently higher than they would otherwise be if factories could work to maximum capacity.

Briefly summarized, it would appear that the expansion of such food industries depending on the supply of raw materials in short supply, or of limited import availability, is not opportune in the near future. As and when raw materials become more readily available they should be allocated to existing industrial concerns who are actually working below capacity. This will enable patriotic manufacturers to reduce the cost of their product and benefit the general public.

The growth of mushroom food industries is not to be encouraged. In large, well-organized factories, hygienic and scientific methods of production can be introduced, rigorous chemical and microbiological control can be operated at an acceptable cost to

the large producer, which would be impossible to meet by owners of small factories. Without the help of highly qualified and specially trained food technologists, any serious development of the food industry in India is doomed to failure. Climatic conditions are in many instances unfavourable, and any slackness in manufacture would lead to most serious cases of spoilage of products and possibly food poisoning. Therefore, in India even more so than in more favoured temperate climates, the services and advice of qualified food technologists is absolutely essential to the success of the many branches of food manufacture we are seeking to develop.

Government must enact and insist on the highest standards of hygiene, together with a standard of purity acceptable to the world in general.

The foregoing views present a not too happy picture of the prospects of rapid development of the industries mentioned, intimately connected with the use of sugar, and more concentrated efforts must therefore be applied in the direction of food industries dependent on more easily available indigenous raw materials for their product.

A practical example of an industry of this description can be seen in the manufacture of Food Yeast from the waste material of a Sugar Factory—namely molasses.

The conversion of an unpalatable carbohydrate into a protein of high biological value has attracted the interest of nutrition experts throughout the world.

The Nellikuppam factory of Messrs. Parry & Co., Ltd., have operated a Pilot Plant capable of producing 2 tons of Food Yeast per mensem for over 8 years. Difficulty is experienced in marketing even this quantity through ordinary commercial channels. The reason for this is primarily the lack of sufficiently powerful official propaganda advising the general public on the benefits to be derived by the addition of a small quantity of Food Yeast to the daily diet. If it were found possible for the Union Government to introduce a compulsory daily intake of food yeast in admixture with normal rations to all members of the Defence Forces, institutions and prisons, etc. the natural resentment to

the use of a completely new food might be more readily overcome. The cost of production of food yeast on a pilot plant scale is naturally out of proportion to that attainable in a full-scale factory. The only full-scale factory producing food yeast in the world is producing it at, it is believed from reliable sources, one shilling a pound (say, 12 annas per lb.). At this figure, food yeast is made available as a protein food which pound for pound is the cheapest in the world. Just as an example, we may name beef or mutton which, at an average cost of about 14 annas per lb., contains less than one half the protein of food yeast. The additional valuable asset of a high Vitamin B_1 content is not to be found in any other form of food. Food yeast contains as high as 3·2 mg. per 100 gram B_1 complex which is ten times that of most other common proteins such as meat, milk, dried peas and beans.

Technically, the design and operation of a Food Yeast Plant in India should offer no serious obstacle. The disposal of the product is the major problem, which fact limits the possibilities of any commercial concern taking any interest in the manufacture of a product which demands an extremely large capital outlay. The prospects of large-scale production of Food Yeast are therefore not too encouraging. Substantial quantities could, however, be very easily and beneficially incorporated by various food industries prepared to manufacture tinned soups, soup cubes, and many other products which require a full meat flavour but not necessarily with the use of any meat ingredients.

Products such as vegetable soups, tomato and spaghetti etc. prepared with the aid of autolyzed yeast products should have a distinct appeal to the vegetarian communities.

The production of autolyzed yeast products and extracts is not new in India; large quantities of yeast extract of equivalent standard to the well-known 'Marmite' were supplied by Nellikuppam to the Supply Department for our Defence Forces during the war.

Again, for the lack of sufficient demand in peace-time the production of this valuable food and source of Vitamin B complex had to be suspended even on a pilot plant scale.

Baker's Yeast

About two years ago the import of Baker's Yeast was suspended and regular users were informed that 'Baker's Yeast' was available in the country. At the time this statement was made, Baker's Yeast was not being manufactured by any Company in India—a misunderstanding had occurred confusing food yeast with baker's yeast. Food yeast of course being of the *Torulopsis* strain is useless as a yeast for bread making. Immediately we were deluged with orders for a Baker's Yeast. Within a few weeks the Food Yeast Plant at Nellikuppam was rearranged and equipped for the production of baker's yeast in the form of pressed yeast and of a quality unsurpassed by any imported yeast. The market for Pressed Yeast is mainly in large towns and mostly in North India where bread is consumed in far larger quantities than in South India. Having overcome the process technique adapted for tropical conditions, the major problem of transport to distant places without cold storage rail facilities had to be faced. Air transport has been found fairly suitable but delays do occur, and due to the perishable nature of freshly prepared yeast it is quick to deteriorate. Moreover, the cost of air freight to Calcutta is more than the cost of the yeast ex-factory, and supplies have also to be limited to cities having direct air contact with Madras. Despite these very real difficulties it has been found possible to successfully replace imports of Pressed Baker's Yeast. The expansion of this industry will depend on the rapid modernization of the bakeries in India.

Large modern machine bakeries are dependent for success, on the availability of a standard quality yeast, and the production without fail, of a standard loaf of bread. Desiccated active yeast for bakers is also a product now under experimental production. The baking quality of a dried preserved Yeast of this type is of course below that of active fresh yeast and the large bakeries in India have quickly realized the value of the fresh yeast they have received as compared with imported Dried Yeast. Nevertheless, the production of a Dried Yeast which does not require cold storage facilities will have a definite market in many bread-producing areas which cannot be reached by air or are not

equipped with cold storage plants. This short résumé of a pioneer industry in India indicates a few of the external hazards to be faced even when manufacturing technicalities have been successfully overcome. To ensure the successful expansion of food industries, technical proficiency must be backed by sound commercial organizations capable of handling the distribution of the manufacture.

FOOD INDUSTRIES AND REQUIREMENTS OF THE DEFENCE SERVICES

by

B. Banerjee

(Ministry of Food and Agriculture, Food Division, New Delhi)

The Army needs a large variety of processed foods in 'ready to serve' form such as canned fruits and vegetables, tinned milk and butter-milk, sweets, chocolates, biscuits, sugar products such as groundnut, roasted and sugar coated, hydrogenated oil, etc. In this note, these requirements have been reviewed. Some of the industries have actually grown up on account of the encouragement given to them by the Ministry of Defence and Food during the War. The army still needs, although on a restricted scale, these varieties of foodstuffs, apart from sugar, hydrogenated oil, etc. Other industries are not producing stuffs of the required quality. It is therefore necessary that these industries should improve their products, by adopting more modern methods of processing. The purpose of processing should be to improve the appearance, palatability, nutritive value and storage qualities of foodstuffs.

In this note I have tried to review the various food industries in relation to the requirements of the Defence Services. Some of the industries have actually grown up due to the encouragement given to them by the Ministeries of Food and Defence during World War II. They require much more improvement so as to enable their products to compete fairly well with imported stuffs. Apart from a few industries, like sugar, hydrogenated oil, which have developed to a large extent during the last 20 years, there is hardly any other industry which can be said to run on modern scientific lines. The purpose of processing should be to improve the foodstuffs from the point of appearance, palatability, nutritive value or to preserve the perishable foodstuffs.

1. Canning

Nicolas Appert, known as the father of canning industry, began his study on food preservation, stimulated by a prize from the French Government for better methods of preserving foods for Napolean's Army and Navy. The canning industry has developed in other countries as a result of various wars. But in order to make the canned products popular in this country it is not necessary to rely on the occurrence of war. One of the important requirements for the development of canning industry in India for the preservation of fruits and vegetables is the tin container. The present type of tin container which is available to the canning industry is an ideal one. It is made from tin-plate and so fabricated that the solder does not come at all in contact with the fruits and vegetables packed inside the container. Moreover, the hermetic sealing is achieved by double seaming machine which does not require any soldering. Special lacquers have been developed for fruits and vegetables. More research work is being carried out and recently it was reported that by the Protecta Tin Process which consists of the treatment of the tin-plate by an alkaline solution, the necessity of lacquering is no more felt and the container is made resistant to both rust and staining. In order to produce canned fruits and vegetables of good quality, it is necessary that the raw materials must be available of the right quality in good quantities. This is a problem in India. The produce is not usually of the same variety, of the same size, maturity and colour. It is, therefore, difficult to stick to the same quality of fruits and vegetables. In countries where canning has developed to a large extent, simultaneous development has also taken place in the cultivation, growing and grading of fruits and vegetables. It is well known that the quality of raw material has a direct effect on the keeping quality of the canned products. Sugar and salt, the two important raw materials are not available in this country conforming to quality standard. These two ingredients are also required to be free from thermophylic bacteria. Fruits and vegetables should also be clean with low bacterial counts. Otherwise, the process of sterilization is very heavily loaded and too long a time and high

temperature will be required for the processing which may adversely affect the quality of the products. The Army is the greatest consumer of canned fruits and vegetables. During 1950–51, they purchased large quantities of canned fruits and canned vegetables, both in brine and as curried. The Army is also purchasing jam and marmalade. It is really due to the purchase of canned foodstuffs for the Army and the encouragement given by the Ministries of Food and Defence that the canning industry in our country has grown up to the present position. The production has increased and the quality has improved. The difficulty experienced by the Ministry of Food and Agriculture (Food) is that now-a-days they do not get good, specified and graded types of canned vegetables at a fair price throughout the year. For example, in summer the number of vegetables available at reasonable price is very limited. Sometime in the year the number of fruits suitable for canning is also limited. Recently, the Central Food Technological Research Institute has been requested to study the suitable condition for canning of bananas with a view to increasing the supply of fruits canned in syrup. The Army is also purchasing pre-cooked *dhal* tinned. The industry should explore the possibility of canning fish on a large scale. They have been producing canned fruits and vegetables in good quantity but the problem regarding canned fish is still in an experimental stage. The Army is also interested in canned fish and as such this industry should be developed.

2. Wheat Milling

Before the war, the roller flour mills in India used to produce semolina and flour from wheat. In this process a large amount of wheat had to be discarded as bran which could be used for animal food. When the supply position of wheat became difficult it was thought that the production of semolina and flour was a luxury and with a view to economizing the wheat, the production of wheat products was stopped and only *atta* was produced. In this country a large proportion of wheat is used ground either in homes or in *chakkis*. The roller mills are used to produce mainly flour and semolina. With the stoppage of production of

this article, the roller mills had to remain idle and only those mills which undertook to grind wheat into *atta* remained in production. At present two roller mills are engaged in grinding wheat into *atta* for the Army. As the percentage of extraction of *atta* for the Defence Services requirements is as high as 95 per cent, in which case *atta* would contain larger quantity of phytic acid which would interfere with calcium absorption, the flour mills are fortifying *atta* with Creta Preparata B.P. 'Novadel Mixer' was imported for mixing the calcium carbonate with *atta* but the mills have reported that 'Novadel Mixer' is unsuitable for the purpose and that is why they have been using 'Horse Shoe Mixer'. Now, it is for the industry to devise a suitable type of Mixer which would give better service and reliable and uniform mixing.

3. Dairy Products

The supplies of milk in India are very limited and there has been further reduction during the last few years. Where production of ghee is prevalent, attempts were made to manufacture skimmed milk powder. Perhaps only two firms were successful in producing skimmed milk powder. This was imported into this country to a large extent and was used for toning buffalo milk. Buffalo milk contains a larger percentage of fat than cow's milk. Skimmed milk powder and water were added to it and the percentage of fat was adjusted at a level equal to that of cow's milk. Skimmed milk powder was also used after reconstituting it into liquid milk and adding to it hydrogenated oil to serve as fat and carotene to serve as vitamin A. The Army purchases quite a good amount of milk powder, *milk tinned condensed sweetened* and *milk tinned evaporated unsweetened*. Like milk powder, *milk tinned condensed sweetened* and *milk tinned evaporated unsweetened* are not manufactured in India and hence the Army requirements for these products are imported from Australia, Holland and the U.S.A. As it has been decided now that if the milk on storage becomes browner, thicker or caramelized, it would be considered to be normal and not affecting the quality of the milk, the Indian manufacturers should take up

these industries so that the Defence Services may not have to depend entirely on other countries for the supplies of milk powder and evaporated and condensed milk. We cannot make use of the large plants available for the manufacture of such products. The production of milk in our dairy farms is limited and it would be advantageous if we could obtain a small plant for the manufacture of the above products. Tinned butter and cheese are also being purchased by the Army. The tinned butter as produced in India has shown that melting in summer season gives rise to objectionable physical conditions consequent on melting and also emits rancid flavours. The industry should consider whether they could manufacture something like butter concentrate as manufactured in Australia which is suitable to be used in hot climates.

4. Chocolate and Cocoa Powder

Chocolate is a nutritive food and was included in the Emergency Pack for the U.S.A. Army. Cocoa powder is used in preparing patent food products like Ovaltine, Bourn-Vita, etc. They are excellent invalid foods and as such the manufacture of such foods may be taken up as a subsidiary industry by chocolate and cocoa powder factories in India. Attempts were made during the first World War to manufacture chocolate and cocoa powder in India as there was practically no competition with the foreign stuff due to import restrictions, but the efforts could not survive the peace years on account of competition with the imported chocolate and cocoa powder which were definitely superior to the indigenous stuff as regards flavour, blending and smoothness. By the use of modern machinery and a good blend of different varieties of beans, the difficulties are likely to disappear. But the main difficulty is regarding the supplies and price of cocoa beans which are not grown in India and have to be imported. Attempts were made to cultivate cocoa plants in India so that we may not have to depend on imports. It is necessary that all the processes, right from the crushing of the beans, should be carried in the factories. The Defence Services require chocolates as an emergency pack. The normal type of chocolates melt at

a high temperature in summer. Such chocolate bars which would not melt at high temperatures should be manufactured in India. These bars could be made with crushed roasted groundnuts in order to improve the protein value of the chocolates.

5. Hard-boiled Sweets

Hard-boiled sweets are being purchased for the Defence Services. Much improvement on this stuff so far as quality, flavour and packing is necessary.

6. Groundnut Roasted and Sugar-coated

The Army is also a consumer of groundnut, roasted and sugar-coated. But the stuff as produced in India is far from being satisfactory. Generally, the right type of groundnut is not used. Sometimes, the groundnuts are not properly roasted, and sometimes the coating of sugar is not uniform.

7. Biscuits

Ministry of Food were purchasing Biscuit 'Shakarpara' during the last war and afterwards for the Defence Services; but, they were not liked by the troops for their unappetizing appearance, poor colour and lack of crispness. The recipe has now been improved by the elimination of bran, (as 95 per cent extraction *atta* is being used) by using a mixture of *atta* and flour in equal proportions in place of *atta* only and by increasing the amount of sugar. The biscuits have been made thinner and the sizes have been diminished and as such the biscuits at present produced for the Defence Services have become appetizing and tasty and are like fancy biscuits. But the real difficulty is that the Ministry of Food and Agriculture (Food) do not get good response from the trade for the supply of biscuits to Defence Services. The trade must take interest in supplies to the Army.

8. Hydrogenated Oil

During the war the supplies of ghee diminished to a great extent and the demand for hydrogenated oil increased precipitously. It was found necessary to increase the production of

hydrogenated oil to meet the demands, as people accustomed to ghee could take hydrogenated oil but could not take any other edible oils. There was some controversy as regards the wholesomeness of the hydrogenated oil as an edible substance as a result of which the Ministry of Food formed the Vanaspati Research Planning Committee. The Committee has since found that there is no deleterious effect produced by hydrogenated oil. In spite of the increased production of hydrogenated oil there is still a great demand for it. The Army is one of the great consumers of hydrogenated oil.

9. Soyabean Milk

The production of soyabean milk attracted much attention and it was found out by feeding trials at various institutions that soyabean milk had a supplementary value when given as a substitute for milk. Unfortunately, soyabean is not grown on a large scale in this country and it has been difficult to get people to grow it and produce the milk. A proposal is under the consideration to set up a soya milk pilot plant in India with a view to producing soya milk for issue to military personnel.

FLOUR MILLING INDUSTRY IN INDIA

by

Sri Premnarain

(The Ganesh Flour Mills Co., Ltd., Delhi)

There are about 81 flour mills in the Indian Union with a total capital outlay of about 10 crores and an aggregate grinding capacity of 1.8 million tons. The industry is largely concentrated in the port-cities of Calcutta, Bombay and Madras and also in U.P. and the Punjab. The welfare and future growth of allied industries such as biscuit factories, bakeries, confectioneries, starch factories etc., depend on the stability and prosperity of the flour-milling industry.

The paper deals with problems of the industry such as (1) neglect and apathy of the State, (2) shortage of supply of wheat, (3) prejudice and lack of general education of the public, and (4) want of active association with science and scientific research.

I propose, in this short paper, to make an attempt to discuss the present position of the Flour Milling Industry in this country, its importance both economic and nutritional and certain problems facing it and how, in my opinion, these should be tackled.

The place of the Flour Milling Industry in the Country's Economy

One of the oldest of the modern large-scale industries to be established in India, the flour-milling industry developed at a quick pace in the first three decades of this century, mainly to cater to internal requirements for its specialized products viz., white flour, *soji* and *rawa* though the mills at the principal port-towns of Bombay, Karachi etc., were also able to spread out their trade of respectable dimensions to certain foreign markets. The statistics collected before the partition of the country showed that there were 116 mills with a capital investment totalling about 14 crores. The position after the division of the country is that 81 mills fall into the Republic of India with a total capital at charge of about 10 crores and with an aggregate grinding capacity of 1.8 million

tons. The industry is largely concentrated firstly in the port-towns of Calcutta, Bombay and Madras with a total number of 25 mills and grinding capacity of about 7 lakh tons and next in U.P. and the Punjab with 17 and 16 mills respectively and grinding capacity of 360,000 tons each. The rest are fairly spread in other parts of the country.

The foregoing data are enough to establish the fact that the flour-milling industry is an asset of considerable economic importance to the country which, therefore, instead of being allowed to languish, should be exploited to the utmost advantage.

Nutritional Value

The flour mills are now acknowledgd all over the world as sources of clean and wholesome products. Being equipped with the efficient mechanical and scientific devices for cleaning, washing and drying of grain, not otherwise available, the grain is put into an ideal condition for being processed into various products. No trace of dirt or dust remains and foreign grains are almost completely eliminated from wheat. This in itself is a gain of inestimable value compared to the crude grinding processes still largely used in this country. Apart from cleaning of the grain, its further treatment for conversion into different products is far more scientific and there is the minimum loss of natural nutriment. The whole-meal *atta* produced by the mills is much more nutritive and wholesome and suited to human digestion than the corresponding product produced by other means. Even more, results of the latest nutritional research with a view to enriching the porducts can only be made good use of in flour mills. It is now known that addition of calcium and synthetic vitamins etc. to flour during the process of manufacture in Great Britain and elsewhere has been adopted with great advantage to the health of the people.

It is obvious, therefore, that the flour-milling industry is in a position to make a great contribution to the health of the masses if properly encouraged to do so.

Relationship with Allied Industries

Importance of the flour-milling industry has another aspect also and that is the dependence on its products of certain allied industries such as Biscuit industry, Bakeries, Confectioneries, Starch industry etc. Exact figures of the quantities of flour-milling products consumed by these industries have not, unfortunately, been available, but it is quite obvious that the consumption is very large already and then these industries are still growing to great economic advantage inasmuch as the country saves substantial amounts of foreign exchange on corresponding imported products.

The welfare and future growth of these allied industries also depend, therefore, on the stability and prosperity of the flour-milling industry.

Problems of the Industry

The problems of the industry fall into four categories, namely (1) those arising from State's neglect or apathy, (2) those created by political developments in the national and international sphere, (3) those caused by prejudice and lack of general education and (4) those which may be termed scientific. The first of these categories calls for a priority of discussion because it is more or less the parent of most of the difficulties in the rest of them.

State's Neglect and Apathy

In the absence of any kind of measure of State attention before the last World War the industry grew to be a typically over-developed industry. Quite a number of units had to remain idle for some part of the year due to uneconomic competition within the industry. The mills installed were chiefly designed and equipped to produce white flour so that neither by their technical arrangement nor even otherwise they could work economically on the basis of production of whole meal *aṭṭa* alone. And, for the white flour, the country's existing demand was much less than the installed capacity for production thereof.

When the war came on, amongst the industries this was perhaps the first and the worst casualty. In the various measures of

controls on the movement, distribution and prices of wheat and wheat products adopted by the then various Provincial Governments, the industry as a rule was never consulted and its interests always came last, if at all. After a good deal of agitation at any rate in some of the provinces, individual units of the industry were brought into rationing schemes, but the industry as a whole languished partly for want of grain but mainly perhaps because of the severe and even prohibitory restrictions placed on the production of white flour which, being its major product, is the very life-blood of the industry. This very state of affairs more or less still prevails and it will be no exaggeration to say that the industry is in a half-dead condition and there are hardly any signs that the State has any thought of enquiring into it with a view to its revival. Sometime ago the Government at the Centre appeared to have exhibited some interest in this direction, but no active steps have thus far been taken. In such a state it would indeed be idle for any one to think or talk of any further expansion of the industry.

Unfavourable Conditions Created Internally and Externally

The partition of the country on the one hand and the existence of continued war-like conditions in the international sphere on the other, have created another set of difficulties facing the industry. The areas now included in West Pakistan constituted by far the main source of supply of wheat to the industry throughout the land. The loss of this source of supply of wheat is a very serious blow to the industry and one feels legitimately doubtful if the industry can be fully revived till the country, through its long-term schemes of river valley irrigational projects, becomes self-sufficient in the supplies of its wheat requirements. The present scarcity conditions make the position all the more difficult because whatever wheat can be imported has to go to meet the primary rationing and feeding requirements. The difficult and almost war-like international situation, when surpluses in wheat production are more inclined to stock piling to meet emergencies than to export, considerably limit the possibilities of foreign wheat being made available to the industry. There is also, in this

situation, the difficulty of importing machinery for replacements and modernization of plants.

Problems of Prejudice and Lack of Education

No serious attempt has ever been made in this country to educate the public into understanding the role of flour mills as a source of supply of wholesome, nutritious and hygienic products compared to what they get from the power-driven *chakkies*. Even the Government seems to have somewhat shared in the general prejudice against flour mills as was apparent from the fact that the *chakkies* were in the beginning, during war years, generally favoured at the expense of the flour mills for supplies of *atta* in the rationing and rural areas. Instead of discouraging the people in their unenlightened preference for drawing their rations in the form of wheat, only to be taken to the *chakkies* by them individually for being ground into *atta* instead of in the form of wholesome *atta* produced by flour mills, the Government sympathized with it. Only the people themselves became wiser by experience as was shown by the example of Amritsar where at the commencement of rationing only about 10 per cent of the people drew their rations in the form of atta produced by flour mills but in the course of just some months this percentage increased to as much as 90. The same would appear to hold good for other towns as well.

The fact, however, remains that due to commonly prevailing prejudice and lack of general education *chakkies* have grown in urban as well as in rural areas like mushrooms giving rise to an unhealthy and uneconomic competition between them and the flour mills. The Government and more particularly the Health Services neither at the Centre nor in the States have turned their attention to this aspect of the problem which, apart from its effect on the industry, is so very vital to the health of the nation. In some of the more advanced countries the Governments are understood to be insisting on additional enrichment of flour according to the nutritional deficiencies of the inhabitants of particular districts but here in our country the Health Departments do not appear to be concerned even to see

that the people are supplied with products which at least contain the maximum natural nutrition and are hygienically prepared.

Problems of Scientific Nature

In common with many other modern industries in this country, the flour-milling industry has suffered from want of active association with science and scientific research. No scientific association, Governmental or private, has anything to do with this industry. So far as this industry is concerned there has never been any serious talk of making available to it the benefits of sustained scientific research for any advancement, therefore, whether in the technical field or in the matter of affording better service to the consumers of its products, it is entirely dependant on what trickles down from foreign sources, thus without being able in any degree to keep abreast of the achievements elsewhere, more so because the industry's own capacity for introducing improvements has been sapped by the war and after-war conditions. Then, the possibilities of the establishment of subsidiary plants with a view to more economic use of the industry's by-products, *e.g.*, mixture of bran and oil cakes, production of wheat germ oil etc., have not even been seriously explored.

Such are then the main problems of the flour-milling industry in India, which must be faced and solved in a planned, vigorous and sustained manner. The industry is too important economically and even otherwise to be allowed to languish as has been the case for long now. The principal role in reviving the industry and in solving its problems has, in the very nature of things, to be played by the Government at the Centre and it is only to be hoped that it will not be long before they give the lead, provide necessary encouragement and assistance and also call the members of the Industry to a conference for a detailed discussion of their problems and difficulties with a view to the same being attacked in a united and co-ordinated manner.

FOOD YEAST

by

K. Lakkappa

(Chemist, Mysore Sugar Co., Ltd., Mandya)

The paper describes the manufacture of food yeast and puts forth a plea for the production of food yeast in India. It is suggested that suitable legislation should be passed to introduce the use of food yeast in the Indian dietary.

THE molasses discarded by the cane sugar factories serves as raw material for numerous industries. It is used as such or as fertilizer, fuel, cattle feed, etc. Its content of fermentable sugars is also converted into solvents, industrial alcohol and acetone, into organic acids, acetic, lactic, citric, oxalic, etc. or into fuel, de-hydrated alcohol. It is largely used in the manufacture of yeast. More uses for this valuable industrial waste-material are continuously being discovered.

Yeast, as a food, first received attention during the World War I when the Germans produced it in large quantities mostly from wood sugar solutions and air. The data, however, show that the project was not very successful due to feeding more yeast than necessary for the system. The second World War, like the first, greatly stimulated interest in Food Yeast and the estimated rate of production in Germany was about 100,000 tons annually. Great Britain thought of using dried yeast as a food for live-stock and later, when the food supply deteriorated, considerable thought was given to supplement, with this article, the diets of people in colonial possessions. Thaysen and his co-workers developed a thermophilic, rapidly-growing strain of *Torulopsis utilis* var. *thermophil* which could be propagated in tropical countries, and a plant was erected in Jamaica, B.W.I., to produce this yeast on a large scale. The inclusion of yeast in the human dietary is based chiefly on its supplemental value, mainly for supplementing the amino acid and vitamin deficiency of cereal grains.

In the United States, I visited a number of Yeast Factories

manufacturing millions of pounds of compressed yeast. One factory, The Anheuser Busch Co., St Louis, Mo., manufactures 100,000 lb. of Baker's Yeast per day. In India the food situation is so serious and still we have not thought of erecting yeast plants. The reason for this is very simple. The Americans value yeast for its protein and vitamin contents. In India the people are still worried about flavour, taste and other minor objections. If Americans take yeast in the form of bread, we can incorporate yeast in our diets and consume just the required quantity every day. I may add that about ¼ oz. of yeast a day keeps the doctor away.

It will be good for us if suitable legislation is passed regarding the use of food yeast in our diets. By this, the Mysore State will again be the pioneer in this field as they are already so in many other industries. In a few months we can have a Food Yeast Factory in operation at Mandya. I am not speaking of these things as an optimist. The following lines will illustrate the strength of my statement: In May 1941, President Roosevelt called a National Nutrition Conference for Defence. The effective date of a standard for enriched flour under the Food, Drug and Cosmetic Act was announced. At first, enrichment was voluntary on the part of millers and bakers, and by the end of the first year, about ⅓ of white bread was enriched. By the end of the second year, about ¾ of all family flour and baker's white bread was enriched. In January 1943, War Food Order No. 1 required enrichment of all baker's white bread. In October 1943, an order required higher levels of iron, thiamine, and niacin and made the inclusion of riboflavin mandatory. The enrichment is still voluntary except in those States that have passed legislation. The National Research Council is interested in seeing that the benefits of enrichment are available to all people. Its staff is prepared to give scientific information to any group interested in enrichment. This trial seems to indicate that enrichment of flour and bread is an effective, practical, and economical way to raise the level of thiamine, riboflavin, niacin and iron for every one. It is to be hoped that we shall have the same facilities in due course of getting more proteins and vitamins through usage of yeast in our diets.

The yeasts are micro-organisms widely occurring in nature Each cell varies from 3 to 12 microns according to species o strain, but its three essential parts are always present: the cell wall, the cytoplasm and the nucleus. The vacuole is often alto gether absent. On the basis of their morphological and physiolo gical features, the yeasts are divided principally into two group —the true and the false yeast. All cells need food to keep aliv and to develop enough energy for their bio-chemical processes Dried yeast occurs as yellowish-white or weak yellowish-orang flakes, granules or powder. It has numerous irregular masses an isolated yeast cells up to 12 microns in length and 2.5 micron in width.

Yeasts are cultured by standard bacteriological methods. I fermentation industries, the problem of maintenance of cultur is a critical one. The synthetic culture media for development o pure cultures have to be supplemented with certain comple organic molecules, called 'Growth factors' or 'Bios', so that th cells can develop abundantly. Malt wort agar slants are use for preservation of yeast cultures. Fresh transfers are made a intervals varying from 1 to 6 months followed by short incubatio at 20–30° C. and then by storage at temperatures from 5° t 15° C. Sub-cultures are made from stock cultures for th factory process. The latest procedure for preservation of culture is Lyophilization technique by which it is possible to keep culture viable for very long periods without refrigeration.

Manufacture of Food Yeast

The molasses is first clarified to eliminate impurities. Th common method is the precipitation with calcium and ammoniu phosphates. The acidity of the clarified wort is adjusted an enriched with phosphates. The laboratory yeast is inoculate and either the continuous or the batch process may be followe maintaining the optimum conditions of pH, nutrients feed, aera tion, and temperature. Next, the yeast is separated from th wort by centrifuging at high speed which gives a concentrate yeast containing 15–20 per cent solids. This is taken into a holdin tank where it is washed, neutralized and aerated intensely b

which process some resins, colour and acidity of the cells are eliminated. The yeast is again spun giving us a cream with good appearance, odour and taste. The cream is dried in rotary driers and the thin film of yeast is passed through a mill in order to get a product in powder form, uniform and more compact. The product is bagged in paper bags. The Baker's Yeast is manufactured by filter-pressing the yeast separated from the centrifugals and marketing the same in lb. packets to bakeries. The latest development in the production of Baker's Yeast is the product sold in the form of dried pellets. The manufacturing cost will not be more than six annas per lb.

Production of High Riboflavin Yeast

The flask culture is inoculated into wort in ten gallon pressure cooker and aerated for 20–24 hours. This is transferred into 100 gallons of prepared medium in Ribo Tank A and aerated for 16 hours at 32° C. and yield must be 1.6–2 cc. of yeast per 15 cc. or slurry. The entire contents of Ribo Tank A are aseptically transferred into Ribo Tank B, which contains 800 gallons of sterile water and 45 gallons of feeding mash. The medium is aerated and mash fed. The contents of Ribo Tank B are next transferred to a commercial fermenter where the concentrate should be 15 gr. of solid per 100 cc. This is pumped into 8,000 gallons plant fermenters and aerated, maintaining the temperature at 34° C. A potency of 500 mg. of riboflavin per gramme of yeast should be reached after 6 hours of aeration. By adding sugar periodically, the riboflavin potency can be raised to much higher levels. It may be necessary to add small amounts of ammonium phosphate and potash if very high levels of riboflavin are required. The wort is then pumped to holding tanks and dried on atmospheric double drum drier. The species of yeast used is classified as *Mycocandida riboflavin*. The yield of riboflavin depends on the rate of sugar feeding, strong aeration and the concentration of the yeast in the culture.

Yeast Tableting

To every 100 lb. of yeast, are added 10 lb. of granulating solution and mixed in a mechanical mixer for about 3 minutes; then, it is passed through the micro-pulveriser using 1/16 mesh herring-bone screen. It is transferred to hopper and tabletted.

Uses and Utilization of Yeast

The Food Industry recommends yeast as a means of reintroducing natural plant constituents to food products which are lost during processing. It is used in the manufacture of hard and soft candies, fruit marshmallow, nougat and low-methoxyl pectin candies. It can be used as a flavouring agent along with salt for a number of processed food and nutritional supplements. Non-viable dried yeast is used for the fortification of wheat flour and bread. Yeast is used in the manufacture of plastics and glycerol. Yeast is rich in ergosterol and a large quantity of activated ergosterol is sold in the market under the name 'Viosterol'. Irradiated yeast is also being manufactured in both fresh and dry forms. Yeast extracts are utilized in cultures of bacteria for industrial and medicinal purposes. Yeast contains a valuable enzyme called 'Invertase' used largely by bakers and manufacturers of table syrups and confectionery.

An acre of land produces enough corn to feed a person for 635 days. The same corn fed to hogs will provide enough pork meat to feed a person for only 125 days. Dried yeast is an 'Indoor crop'. Pound for pound, yeast costs only 0.125 as much as meat. It was almost a staple food for Europeans in the Middle Ages. A ten-foot vat can produce as much meat in a year as 1,000 acres of pasture.

It is impossible to raise the nutritional level of India overnight. It is a problem which involves a great deal of education. Experiments have shown that yeast can be introduced into savoury food preparations like soups, sauces, stews and gravies. It forms pleasing combination with syrup and milk drinks. It can be used in bakery products such as cookies, biscuits and pan-cakes. The most practicable way of distributing yeast would be its compulsory addition to flour and ground spices and also in a

programme of feeding people, *e.g.*, in canteens, child welfare centres and factories. The annual output of flour in India is about 1.5 million tons and a Government Order to enrich this with 2–5 per cent yeast is very desirable.

In the beginning, there will be numerous complaints of imaginary ill-effects. The public should be made 'Yeast conscious'. Food Yeast has a great social value and could play a valuable part in healing the 'cuts' and 'scars' of a mal-nourished world. I am of opinion that the Central Food Technological Research Institute will in due course contribute to a very great extent to tide over the food problems all over the country.

Before concluding, I wish to express my gratefulness to the authorities of The Mysore Sugar Co., Ltd., Mandya, and to Dr V. Subrahmanyan, Director, Central Food Technological Research Institute, Mysore, for giving me this opportunity to present my views on this vital subject, FOOD YEAST.

THE BISCUIT INDUSTRY IN INDIA[1]

by

The Federation of Biscuit Manufacturers' of India, Delhi

The growth of the Biscuit Industry in India for the last 50 years and its present position have been described. The Biscuit Industry was started in India about the year 1897 and gradually it built itself up into a very important industry. The Industry played an important role during the war period by supplying considerable quantities of biscuits required for the Army.

The paper deals with the manufacture and also the food value of biscuits. When a large majority of biscuit manufacturers in India were able to produce fairly good quality biscuits, they formed themselves into an Association called the Federation of Biscuit Manufacturers' of India and this Association became practically the mouthpiece of the Industry. This paper suggests ways and means of improving the industry in India. At present, the industry is suffering from want of adequate quantities of wheat flour and suitable types of containers and packing materials. Government should attend to these difficulties as early as possible so that the industry which is now working to one-third of its capacity may be able to work to its full capacity.

History of Biscuit Manufacture in India

Most of the distinguished personages gathered here today may, or may not, be aware that India can today be considered among the major biscuit-producing countries throughout the world. The position has not been achieved overnight, but has been the result of over 50 years of hard work and perseverance in the face of innumerable obstacles and difficulties.

[1] Read by Sri R. Bhaskar Rao, Chief Chemist, Messrs. The Britannia Biscuit Co., Ltd., Bombay.

In order that the facts should be recorded in their correct order, it is necessary to commence this story roundabout the year 1897.

It was during the year 1897 that the biscuit factories, *i.e.*, factories adopting scientific and mechanized means of production began to make their first appearance in our country. I stress 'make their first appearance' but did not make their presence felt. This position was yet to be reached, and in fact, did not come about for many years.

Our pioneers of the Biscuit Industry had their difficulties and hardships ahead of them as they travelled the arduous road paved with prejudice and misunderstanding. The principal opposition of those days was of a foreign origin and one can but acknowledge that it was this strong sound competition that we met in our markets that placed us on our mettle and is in fact responsible for the high degree of scientific production that comes out of our factories today. We are both proud and confident of our achievements and confident of the fact that the gap between foreign produced biscuits and indigenous production has been bridged.

Indigenous biscuit manufacture in its early stages, and in fact one may say for a period of 30 years, was very slow to develop and progress. This can be mainly attributed to the fact that raw materials required in our manufacturing process were not readily available within our own country. Here again, we are happy to report that wide strides have been made to remedy this disadvantage. Likewise, we are happy to report that the prejudices of the past have now been overcome and indigenous biscuits are now accepted by the public as part and parcel of their every-day need. In fact, our problem today is one of insufficient supplies of raw materials of all kinds, with resultant shortage of supplies to all markets and the evils that usually follow from such conditions.

It was not until the early thirties, following the period of world depression, that indigenous biscuit manufacture began to make its presence felt. It is of interest to note that the sugar, fat and the tinplate industries, so closely allied to the Biscuit Industry,

were likewise making progressive strides at about this time. It is, therefore, but right to say that the Biscuit Industry has lived up to, and played its full part in, the industrial development of our country.

This point was ably demonstrated during the war years when the Biscuit Industry supplied thousands of tons of composite food rations for the armed forces. We are happy to state that the composite food rations were welcomed not only by our Indian troops, but also by all the foreign troops who visited our shores during that period. It is also of interest to state that these goods were shipped to distant countries during the war.

We are proud of our sustained war efforts and, rightly or wrongly, consider that our record of production throughout the war years placed our Industry in the category of industries of national importance and with immense security value.

The Process of Biscuit Manufacture

Our principal ingredients consist of pure wheat flour, sugar, fat, ghee, butter, glucose, fresh milk and powdered milk, ingredients that, we have no hesitation in saying, are vitally required for the up-bringing of a healthy nation. Packing paper of all varieties which today is mainly imported from abroad, tinplate produced both locally and abroad and many other materials are required by the Biscuit Industry.

Technical Business

The home cook may vary his or her basic recipes from one baking to another. But this will obviously never do in mass-production. Once the biscuit maker has established his basic recipe including heat and time required for baking, the whole operation continues day and night with scientific accuracy.

There are experimental kitchens, of course, for biscuit experts to try out new ideas and to search constantly for improvements in existing formulae. But none of their creations go on the production line until they have been tested, tasted, re-tested and re-tasted innumerable times.

Let us follow a typical batch of biscuits through the manufacturing process.

First, huge quantities of the basic ingredients, measured down to the ounce, are poured into giant mixers. These mixers, each capable of handling 1,000 pounds at a time, knead and blend the ingredients into a perfect dough. After about fifteen minutes of this mechanical strong arm treatment, the dough is moved to a mechanical rolling machine where it is rolled and re-rolled, in an unending process, into thick sheets.

These sheets are now transferred to a combination roller and cutting machine where they are reduced to proper biscuit thickness, cut to size, pattern and design. Now, the dough becomes a biscuit save for the baking.

Stage one, you might say, has now been completed. Stage two is the actual baking. Here, once again, everything is as scientifically and accurately fed on to an endless Band or Chain which runs through a very long flat oven. The temperature of this oven is controlled to the precise degree required for the particular type of biscuit being produced. Biscuits are normally baked at a temperature ranging between 400 and 500°F. At this temperature all bacteria or germs that may be present are rendered completely ineffective. The speed of the oven is timed precisely so that the dough remains in the oven for exactly the right length of baking time which may vary from 5 to 20 minutes.

From the end of the oven the biscuits emerge slowly, golden brown delicious smelling biscuits in their thousands. Eagle-eyed inspectors watch and check every biscuit. Finished biscuits of perfect colour and texture are set on white trays at this end of the oven for purposes of comparison. Any single biscuit which for any reason does not match these samples perfectly is ruthlessly discarded. Those which pass the test are speeded on to packing in tin boxes and are rushed on to dealers across the length and breadth of India while they are still warm and fresh.

The Food Value of Biscuits

The constituents of a biscuit, being mainly of the cereal, carbohydrate and fat family, have a very sustaining, nutritious food

value. Their compactness and convenience is of considerable assistance to every day life and of invaluable importance on occasions of emergency. The calorie value of a biscuit ranges between 130 and 170 depending upon the particular biscuit concerned; and it is of interest to note that there are sufficient calories in an average of 1 oz. of biscuits to provide 7 per cent calories declared by world statisticians as being necessary for the human body each period of 24 hours. As opposed to most other foods, biscuits contain vitamins and minerals of the calcium and phosphates family which are essential for the maintenance of good health.

The Forming of the Federation of Biscuit Manufacturers' of India

It was during the early part of 1945 that biscuit manufacturers working on modern principles of production formed themselves into a Federation and this has now become known as *The Federation of Biscuit Manufacturers' of India.* The affairs of the Federation are conducted under the able guidance of a President, assisted by an Executive Committee. It is of interest to note that the President and gentlemen of the Executive Committee have been closely associated with biscuit manufacture in this country for many long years past. They are a tried, trained and proved team, who have in the past tasted the bitter pill of disillusionment and disappointment.

What the Federation of Biscuit Manufacturers' of India Stands For

The aim and object of the Federation is to ensure that good wholesome edible foodstuff is made available to the public at prices within the reach of everybody. The most modern scientific principles of manufacture are followed with full regard to hygiene and cleanliness. The Federation consists of all the leading Biscuit Manufacturers in India whose installed productive capacity is about 30,000 tons of biscuits per annum.

Any biscuit manufacturer seeking membership to the Federation is obliged to apply to his factory and manufacturing process

very definite principles of hygiene and cleanliness and medical treatment for workers engaged in the manufacturing process. By way of ensuring that the principles and ideals of the Federation are rigidly adhered to and carried out, it is the practice of the President to carry out an annual tour of inspection of all member factories. Members of the Executive Committee are sub-divided in all parts of our country and it is their duty and responsibility to enforce the principles of the Federation within their local sphere.

Résumé of the Biscuit Industry (1946–1951)

We feel this paper would be incomplete without making known the difficulties our Industry has experienced over the past few years. In the latter part of this paper we would venture to put forward our suggestions for the future.

The problems of the Biscuit Industry being so closely linked to the country's food situation, it is but natural to appreciate that the position of the Biscuit Industry has been badly affected during the past few years. Owing to Government's inability to provide us with sufficient supplies of wheat flour, the Industry, since 1946 has worked at 50 per cent capacity only and for an average period of not more than 8 months during any one year; leaving aside for the present the prevailing high cost of raw materials and packing materials. The irregular and intermittent periods of operation in our factories and the fact that our factories are not working to full capacity has been directly responsible for serious labour discontent and high overhead costs.

In plain words, the position is simply that on the one hand we have within our own shores an organized Industry capable of producing the requirements of the country, while on the other hand, due to prevailing conditions it has not been permitted to carry on its full share of helping solve the country's serious food position.

Suggestions for the Future

We, members of the Biscuit Industry, feel with certain justification that Government have hitherto failed to give us the due recognition and co-operation to our Industry. As has been stated

in other parts of this paper, the Biscuit Industry can do much by way of assisting in solving the country's food problems and in fact, has already done much in this direction. We suggest that sufficient raw materials should be made available to the Biscuit Industry that will permit a minimum of one 8-hour shift per day at full capacity. A relaxation of the present policy and granting import licences for packing materials, tinplate and many other commodities required by the Biscuit Industry would go a long way towards solving our difficulties. We are confident that if we are provided with materials for at least one 8-hour shift, prices could be reduced and conditions stabilized on a sounder footing than is the case today.

It is essential that the Biscuit Industry should be permitted to develop on the same lines as industries of a similar nature in other countries; and this can only be achieved by a more enlightened and practical view from the point of view of modernization and replacement of existing plant. We, therefore, suggest that existing Biscuit Factories should be free to replace obsolete and worn-out plants by modern ones.

Seldom is it realized by Government or the public in general that biscuit is a perishable commodity. A biscuit should not be exposed to the atmosphere, or if it is, suitable precautions should be taken to ensure that this is not exposed for a longer period than absolutely necessary. Needless to say every endeavour is made by the manufacturer to ensure that his products reach the public in an oven-fresh condition, but this state of affairs can only be achieved with the co-operation of the railways. Unfortunately, co-operation of the railways has been most conspicuous by its absence during the past few years. We, therefore, venture to suggest that in accordance with the country's urgent need for the distribution of foodstuffs, biscuits should be given a higher priority by the railways.

Lastly, but by no means of least importance, is the potential foreign exchange earning capacity of the Biscuit Industry. Prior to the war, Indian biscuits were gaining in popularity in foreign markets as far as in East Africa, Persia and Burma. It is of interest to note that during the war years some of our products

found their way even into Italy. It is, therefore, of vital importance to Government and the country as a whole that the foreign exchange earning capacity of the Industry should be given careful thought. At such time, when internal markets have been satisfied it is within the reach of the Biscuit Industry to regain foreign markets lost during the intervening war years and which have remained un-touched since 1946 for reasons described earlier in this paper.

With the assistance of foreign markets it will be possible for India to improve her standard of living.

ROLE OF ANTI-OXIDANTS IN PROCESSED FOODS IN RELATION TO THEIR STORAGE LIFE

by

N. R. Sathe

(Messrs. Sathe Biscuit and Chocolate Co., Ltd., Poona)

Manufacture of processed foods and also their proper packing are not complete unless the foods so processed retain their nutritive value and their original taste and smell for a long time during storage. The paper deals with the important problem of the rancidity in foodstuffs. Development of rancidity of fat during storage can be prevented by the addition of suitable anti-oxidants. These anti-oxidants inhibit the oxidation of oils and fats. The paper deals with several types of anti-oxidants and their use in various types of processed foods. Thus, it is necessary to make a proper choice of anti-oxidants to suit each type of processed food. This requires careful investigation and research. Besides, it is also imperative that processed foods should be properly packed in special types of packing material that will resist oxidation in foodstuffs on storage and ultimately help maintain the standard of quality of foodstuffs

THIS is a unique occasion of its kind when most of the prominent people of India working in the field of food processing and nutritional research have come together to discuss one of the vital problems of life, viz., food and nutrition. The following survey is not purely a research account; but, it comprises day-to-day observations during the course of working, backed with the latest world developments in food processing and packing. It may give food for thought and guidance to the Indian food processing industries.

BASIC NEEDS OF LIFE

Food, fresh air and water are the basic needs of life. Nature has provided an abundant supply of air and water, but very scanty means of food.

Carbohydrates, proteins, fats, minerals and vitamins are the essential constituents of food and a combination of all these in a suitable proportion is called a balanced diet. Hardly does one find in nature such a perfect and balanced diet, except milk which is only a provision made by nature for infants, till the time they are in a position to assimilate the complex carbohydrates and proteins for growth, repair and reproduction.

Very few foods are readily assimilated in the body, but a majority of them require pre-treatment and processing before they are fit for consumption, irrespective of the source of food which may be either from animal or vegetable kingdom.

Processing of Food

Baking, frying or cooking make food suitable for digestion no doubt, but the presence of flavours, appetizing colour and good taste also add to the value of food.

Preparing wholesome, nutritive and palatable food is an art and a science. Food freshly prepared is sterile, but is likely to deteriorate when exposed to atmospheric conditions.

The responsibility of the food processor is very great and he has to take utmost precautions to protect food from contamination, infection or rancidity, as he is running the highest risk of maintaining the health of the nation and, moreover, his own reputation. Means have been developed to protect processed foods, from invading bacteria or moulds by strict hygienic conditions of the processing room and sterilization of the containers, etc. But these precautions do not retard rancidity.

Phenomena of Rancidity

Fats and oils or products containing a fair proportion of fat, acquire on storage a disagreeable odour and taste, which is accompanied by the formation of either fatty acids, aldehydes or ketones of lower number of carbon atoms. The senses of smell and taste perceive that a particular fat or oil has turned rancid. Rancid fats are not properly assimilated in the body, they are irritant to the sensitive membrane and upset the vitamin balance

or their absorption which are very sensitive and susceptible to oxidation. Huge quantities of products are rendered unfit for human consumption every year and are wasted.

Three different sets of reactions are responsible for rancidity in oils and fats.

(1) The action of moulds or enzymes in the presence of moisture—hydrolyzing the neutral oils and fats to fatty acids and glycerine.

(2) Effect of oxygen on the glycerides of lower fatty acids in the presence of certain moulds and moisture giving rise to corresponding methyl ketones of lower number of carbon atoms, called 'perfumed rancidity'. The extent of this reaction is limited to a particular extent.

(3) Addition of oxygen on unsaturated linkage forming peroxides, (according to E. H. Farmer and his colleagues, addition of oxygen molecule, at ordinary temperature, takes place in the alpha position of the double bond) with the intermediate formation of hydro-peroxides which further leads to fission product of the nature of fatty aldehydes, apparently of epihydrine aldehyde.

The first two causes of rancidity can be remedied by strictly observing the hygienic conditions, sterilizing containers and proper storage of food. The third cause is due to invisible onset of oxygen supplemented by some sort of activating energy such as heat, light or chemical energy derived from molecules of reactive substances in the oil which are at a high energy level. The molecule of oxygen combines with molecule of oil to form a peroxide—liberating the activating energy taken up in the beginning which is made available to repeat the same reaction just as a catalyser. When once set up this reaction will go on till the end, which will render fat completely rancid.

It has been observed that oils and fats of vegetable origin are more resistive to rancidity than the oils and fats of animal origin and the refined oils are less resistive to oxidative rancidity. This somewhat curious behaviour has led scientists to study the cause of the stability of natural rather than of refined oils. After a

number of observations, studying the individual characteristics of a number of oils and fats, the cause has been linked to the presence of some impurity in the oils, derived from the seeds, which is of a non-glyceride nature and a minute quantity is sufficient to protect large quantity of oil. These substances have been called by the term 'anti-oxygenic bodies' or 'anti-oxidants'. Sesamol, (a phenolic compound) in sesame oil, tocopherols (Vitamin E) in wheat germ oil or carrot oil, lecithin (Ciphalins) in soya bean oil or corn oil are some of the natural anti-oxidants.

Thus, the products which inhibit or retard the oxidation in oils and fats are called 'anti-oxidants'; the products which promote or accelerate the process of oxidation are called 'pro-oxidants', traces of metals viz., copper, iron or nickel help the course of oxidation. Certain pigments, *e.g.*, haemine, chlorophylls, etc., with selective absorption of light 'photo chemical energy' are known as 'pro-oxidants' and the compounds which do not act as anti-oxidants but strengthen the anti-oxygenic property of a particular group of products are named as 'synergists'. Citric acid, tartaric acid or phosphoric acid are members of this class which form complexes with pro-oxidants retarding their activity.

Behaviour of Anti-Oxidants

The anti-oxidants have a reactive hydroxy group which shield the onset of oxygen and protect the fat molecule from rancidity, thereby increasing the storage life. Simultaneously, the strength of the anti-oxidants is weakened and slowly destroyed. Thus, the use of anti-oxidants does not assure or guarantee the storage life to any extent of period, if proper precautions are not taken to protect oils and fats from exposure to heat, light or air.

Animal fats and oils are very susceptible to oxidation as they are devoid of any natural anti-oxidants and hence attempts have been made to increase the storage life. The anti-oxidants should be such as not to affect the smell or palate of the original fat and should be non-toxic.

The two products of vegetable origin viz., gum guaiac and nordihydroguaiaritic acid have been found to be good anti-oxidants for lard and butter fat. The latter is rendered

ineffective in alkaline environment as in the case of biscuits and cookies. Increased demand for a variety of processed foods has demanded a variety of products having anti-oxygenic property suitable for a particular oil or fat.

The aliphatic esters of gallic acid *viz.*, ethyl and propyl gallates were found to be good for lard and butter fat, but these being very sensitive to drastic treatment of cooking and frying, they have very little carry through in the baked or fried stuffs. The natural anti-oxidants have a higher molecular weight and hence better resistivity. The Central Institute of Nutritional Research in Holland has shown that esters of gallic acid prepared with the higher alcohols of fatty series *viz.*, octyl or dodecyl gallates have better anti-oxidant properties in all respects. It is worth mentioning here that the heat sensitivity of the lower members of gallates has been entirely eliminated by mixing the anti-oxidant in the oil used for spray after frying. (Food Industries, 1950). This is only possible where an after-spray of oil is given.

Since the War, a number of anti-oxidants have been put on the market of which butyl hydroxy anisol is worth mentioning. The study of anti-oxidants have revealed a number of products, the presence of which retard the rancidity in fats. Sugar increases the storage life in biscuits and cookies—partial hydrogenation also helps to retard the onset of oxidative rancidity. (R. H. McKinney and A. E. Bailey, Oil and Soap, 18, 147–48, 1941.)

After a survey of various anti-oxidants we come to their application in processed foods. Biscuits or chocolates come under processed food and with which practically all of us are familiar.

Biscuits or chocolates contain a fair proportion of fat and are naturally susceptible to rancidity. In the case of biscuits the presence of sugar, partly hydrogenated vegetable fat, phosphates, low moisture content etc., do add to enhance the storage life, and if proper precautions of storage are taken the biscuits may last for more than a year, but in biscuits with large quantity of liquid fats or purely butter fat, addition of B.H.A. or propyl gallate is recommended. As already mentioned, exposure to heat and light reduces the storage life. Retailers exhibit their stores

in show cases or display-windows where direct sun rays impinge, the fat in the stuff melts and comes to the surface which gets oxidized, giving rise to rancidity and off-flavours.

One important factor which has up till now been neglected by most of the food processors viz., the avoidance of rancidity and off-flavours has been recently revealed (G. T. Carlin, Swift and Co., Laboratory, Chicago. Food Industries, P. 1750, 1948) by the study of the packing material mostly used for packing foodstuff such as biscuits, cookies or potato chips, etc. After a number of experiments they have come to the conclusion that the nature and quality of the packing material are responsible for the storage life of the foodstuff. The paper has a tendency to absorb oils and fats, thereby forming a very fine film of fat which facilitates the onset of oxidative rancidity (surface rancidity) considerably than the fat itself. The pro-oxidants which have already been mentioned such as iron, copper etc., invariably present in paper or board, enhance the process. If precautions are taken to avoid the absorption of fat in the packing material the storage life is surely increased and the development of off flavours in cartons can be avoided. The use of parchment or wax paper retard the absorption of fat, but even the side-folds of the packet are sufficient to give access to the oil to creep through the folds and get absorbed in the outer wrapper and be oxidized. The use of anti-oxidants as gum guaiac accompanied by citric acid as synergist in the sizing material for board or paper has been proved to increase storage life in biscuits and cookies about ten times the normal life. Thus we come to the conclusion that the anti-oxidants play an important part right from raw material to the finished packed stage and is of utmost importance to increase the storage life of the product.

Whatever is true of biscuits is also true of all such processed foods which contain some fat or oil. Chocolate, especially milk chocolate is susceptible to get rancid in storage due to milk fat and traces of copper and iron present in the nibs. The presence of tannin bodies and lecithin partly retard rancidity. The storage life is further increased by the addition of N.D.G.A. and propyl gallate. In America and England they have introduced a number

of non-absorbant and hygienic packing materials, such as pliofilm, alkathene etc., which delete practically all the possibilities of spoilage due to rancidity at the same time maintaining the packed stuff in fresh condition.

Confirmatory results have been obtained in our laboratory by trying various packing materials for packing biscuits, cocoa and chocolate, and results to the effect that the nature of the packing material is as important as the quality of the raw material, have been got.

We think that Government should not only assist the food concerns to procure adequate packing material but also insist on their having particular or special type of packing materials which will resist oxidation or rancidity of the foodstuffs on storage and ultimately help to maintain a standard quality.

COCOA AND CHOCOLATE INDUSTRY IN INDIA

by

N. R. Sathe

(*Messrs. Sathe Biscuit and Chocolate Co., Ltd., Poona*)

Spaniards were the first who brought the cocoa bean from Mexico to Europe and thus cocoa powder became a popular drink from the 17th century. Cocoa plant grows only in a warm and moist climate as found in West Africa, Mexico and Brazil. Small quantities of cocoa beans are also produced in Ceylon. This paper deals with the manufacture of cocoa powder and also cocoa butter. Cocoa powder has got a high food value of about 2,250 cal. per lb., and as such it can be considered as an accessory food. It has also been claimed to have tonic influence on account of its theobromine content.

Cocoa is one of the ingredients in patent invalid foods and also in the manufacture of chocolates. It is known that most varieties of infant and invalid foods contain large proportions of cocoa powder.

Chocolate is a fair combination of nutritive principles such as cocoa, cocoa powder, sugar, milk or nuts. Its quality as concentrated and nutritive food is unsurpassed. A lb. of chocolate yields more than 2600 heat units. Such being the case, it could be used even as a subsidiary food to reduce strain on our food resources. The main raw material for this industry is the cocoa bean which is at present being imported from foreign countries. It is necessary that possibilities of developing cocoa plantations in India should be explored.

Many of us might have enjoyed a delicious cup of cocoa or tasted a chocolate bar, but how many of us know or care to know about its origin. Cocoa or chocolate industry was not built in a day. More than three hundred years have passed since cocoa was considered a fancy.

The inhabitants of Mexico were familiar with cocoa and its

preparations since centuries. It was considered as 'the food of God' from which the name '*Theobroma cacao*' is derived. The Spaniards first brought the seed to Spain and thence the secret of cocoa and its preparations leaked out to Italy and Great Britain in the 17th century.

The cocoa seeds were so valued then that a slave could be purchased for a few dozens of seeds, which shows how costly cocoa preparations were at that time. Very shortly afterwards the price was brought down to suit all pockets (just like Penicillin).

Although there is a world market for cocoa the plantations are only restricted to the tropical countries, 20° North or South of the equator. The plant requires special soil and a warm moist climate. As the demand has increased the cultivation areas have also been multiplied.

Gold Coast (West Africa) stands first in production and next to it Brazil (South America, the native place of cocoa seeds). The other small estates like Ceylon, West Indies followed. The cocoa tree is 20–25 ft. in height and bears fruit after four years, but the well-developed boom period is between twelve and thirty when a bumper crop is obtained.

The cocoa seeds are of the size of an almond and 25–40 beans are found embedded in pulp of a crimson coloured pod 3″ cross and 8–10″ long.

At the farm, the cocoa pods are opened and the contents transferred to boxes having false bottoms, to drain, ferment and cure. The cured seeds are dried in sun or in special driers where the moisture is reduced to 5–6 per cent and the germ destroyed.

The dried cocoa seeds are bagged and exported to the consuming countries. Cocoa seeds from different countries possess characteristic properties special to their country of origin.

The raw cocoa seed is bitter and slightly astringent, but when roasted the volatile acids are eliminated and simultaneously the peculiar aroma of chocolate is developed. The protective outer shell which is hard and brittle becomes friable and can be easily removed by breaking the beans and blowing with wind.

The portion of the kernel which is left behind is the most valuable part of cocoa beans.

The shell though of high calorific value is not suitable for human consumption; it serves only as cattle food and a source of theobromine.

The nibs contain 52-54 per cent of oil, 20 per cent digestible carbohydrates, 10-15 per cent proteins and very low cellular fibre (2·6 per cent), which helps the nibs to be crushed to a fine mass. Due to the heat developed in grinding, the fat separates out forming a homogeneous pasty mass which is solidified to hard block on cooling. This is the plain chocolate of commerce.

The cocoa mass can be used either for preparing cocoa powder or mixed with sugar and other ingredients to form chocolate.

By subjecting the cocoa mass to a high pressure in between the filter pads, a part of the oil is pressed out which has a pale yellow or amber colour and the characteristic flavour of chocolate. The residual pressed cake, which still contains about 25 per cent fat, is used as cocoa powder on grinding and sifting.

The analysis of cocoa powder shows that it has got high food value, about 2,250 cal. per lb., surely higher than any average food; but it cannot be used entirely as a substitute food due to its bitter taste on account of its theobromine and tannin content. So, cocoa can be only considered as an accessory food. When prepared as a beverage with milk and sugar, the aroma and colour are so appetizing that one is inclined to drink it. In this form it is palatable and nourishing and of great dietetic value, due to the microfineness of its particles and due to its content in a balanced proportion of fat, protein, calcium and potassium salts, which soothes tired muscles, and removes fatigue of the body maintaining increased stamina. The tonic influence of theobromine mildly tones the nerves, without causing any harm to heart and brain.

Cocoa is one of the ingredients of patent invalid foods—because of its aroma and slightly bitter taste that stimulate the digestive system causing an intake of more nutritive principles.

Chocolate is a fair combination of nutritive principles *viz.*, cocoa, cocoa butter, sugar, milk or nuts. Its quality as a concentrated nutritive food is unsurpassed. A pound of chocolate yields more than 2600 heat units.

Manufacture of Chocolate

Though at the outset, chocolate appears to be a simple mixture of cocoa nib, sugar and cocoa butter, the highest skill is required to turn out a quality product. As already mentioned the process of roasting develops aroma in cocoa beans, but this is not enough. A blending of different nibs from different sources is necessary to impart the right flavour to the finished chocolate.

The process of refining is equally important because the fine velvety texture can only be obtained by a thorough refining of the chocolate in water-cooled refining rollers and finally agitating the chocolate in a conche for a period of 48–72 hours at a slightly elevated temperature, which simultaneously develops the correct flavour, especially in the case of milk chocolate.

The tempering of the chocolate is the last step in chocolate manufacture, which has a miraculous effect on the physical state of the chocolate and finally on the storage quality of the chocolate (curing time).

In the early years the inhabitants of Mexico considered chocolate as food of God and there may be truth in it. This assumption will be justified if we read the latest articles on the nutritional values of cocoa and chocolate. Modern man is not so superstitious as to believe in whatever his forefathers have been saying because, equipped with the knowledge of science, he penetrates deep even into an atom.

This Institute where we have assembled is meant to study and disclose facts, the real truths behind such myths.

Anyhow, the nutritionists and dietetists are justified in saying that cocoa and chocolates are concentrated compact and emergency foods of high nutritive value. In last war sufficient provisions of chocolate were made by all the nations for their army, navy and aircraft.

If cocoa and chocolate are so nutritive then why should India lag behind in production? India must produce and consume cocoa and chocolate as a subsidiary food and ease the acute food situation.

Attempts have already been made from time to time to produce cocoa and chocolate in India, but they have not taken root due to many difficulties.

Mr Sardesai started a cocoa and chocolate factory at Bilimoria during the first World War, but he had to close the factory immediately after the war, due to foreign competition, lack of capital and lack of Government patronage.

There were two small factories, one in Bombay and the other in Delhi, but these too were scrapped due to want of technical hands and impatience on the part of the management.

In the year 1941 when the European nations were busy with war, the foreign imports of cocoa and chocolate were cut off. On account of shortage of the products, our factory was started as a sister concern of our biscuit factory. No imports of machinery were possible and so scrap machinery of the above three factories was amalgamated into one small unit, with a production capacity of 3 cwts. cocoa and 5 cwts. chocolate a day.

When Japan opened a new enemy front, supplies from abroad were completely stopped and ours was then the only factory to satisfy the civilian and to some extent the military demands. During the latter part of the war two other firms, one in Bombay and another in Madras also started production. But later, they too discontinued. Our firm, however, realizing the necessity of organizing the Industry on a permanent basis, approached the Government for assistance which materialized and resulted in the grant of import licence for modern machinery from U.S.A. The unit is gradually developing. Now the production capacity has increased by more than a ton per day.

One thing worth mentioning is that the climate of India, with its extreme variations of temperature and humidity, is unfavourable for the manufacture of chocolate.

We are trying to take advantage of the modern methods of air-conditioning and controlling humidity. If refrigerated railway transport could be made available by the railways, there would be possibility of keeping the factory in production almost throughout the year as there are some places where chocolate can be marketed even in summer.

The other difficulty is about procuring first grade crop of cocoa seeds and lack of correct choice in selecting the grade. As direct supplies to India are not available, the product is to be purchased in London market which increases the delay in delivery and transport cost. Above all these difficulties, the greatest obstacle which is likely to hamper the development of this new Industry, which has just taken root, is the Government's Import Policy, of allowing imports of cocoa and chocolate other than confectionery quite conflicting with the Tariff Board's recommendation to protect this Industry.

The cost of production in India is high for the reasons cited below:

(*i*) Want of trained hands, (*ii*) lack of utilization of the by-products due to smallness of unit, (*iii*) spoilage due to inadequate storage conditions and lack of adequate transport facilities, (*iv*) heavy cost of cocoa seeds and sugar, and (*v*) irregularity of supplies of raw materials—even of indigenous nature.

What Government should do for the Growth of this Industry

Now that India is independent, if Government authorities interest themselves in uplifting the factories by giving adequate protection and facilities, it will not be difficult to build a city of 'Bournville' in India. It is in the interest of the country also to develop this Industry in India which will relieve pressure on foodgrains because of the high nutritive property of the product. In countries like England, Switzerland, and the U.S.A. the per capita consumption is about 1 oz., a day, which amounts to 20–25 lb. per year. There is no doubt, therefore, that people in these countries are better nourished.

The development of this Industry may possibly create new resources for the Agriculturist—our country having all types of climate and soil, it may be possible to grow cocoa plantations in India. (Attempts were made in N. Canara District by the Agricultural Department, but the crop obtained was poor, requiring further experiments.) Take, for instance, the case of Gold Coast, where the production has been considerably increased

during last fifty years from nil to 2 lakhs ton in 1927. Under the present price level cocoa plantations are giving the highest income yield per acre than any price crop. This Institute should impress upon the Agricultural Department of the Government of India to do something in this direction.

PROBLEMS OF THE VANASPATI INDUSTRY

by

Mr G. Ford

(Messrs. Hindustan Vanaspati Manufacturing Co., Ltd., Bombay)

The Vanaspati Industry has been established in India for 21 years. About one-sixth of the available vegetable oil in India is converted into Vanaspati, and the output of Vanaspati is about one-third of that of ghee. The total edible oil and fat resources in India provide for an average per capita consumption of less than ½ oz. per day. The problem of the effect of the Vanaspati industry on the ghee industry is therefore lost in the greater problem of the provision of sufficient fat of any sort for the people of India.

The Vanaspati industry fits in with the general agricultural economy of the country, in that its main by-product, oil cake, is returned to the land as cattle-food or manure. The problem here is to promote a greater use of oil cake as cattle-food, which results indirectly in the production of good manure, rather than its inefficient direct use as manure.

The Vanaspati industry stimulates the development of other Indian industries such as the oil milling industry, the engineering industry, and the tin-plate industry. In particular, it stimulates the oil milling industry to extract oil more efficiently from oil seeds and thus to make a greater use of the country's oil resources.

The Vanaspati industry can make a great contribution to the nation's food resources by converting low grade oils into high class edible products. In particular, the development of the use of cotton-seed oil should be strongly promoted.

Now that synthetic vitamin A is becoming available, Vanaspati can fulfil a great role as a vehicle for increasing the supply of vitamin A to the population of India. It

is first necessary to solve the problem of the stability of vitamin A in Vanaspati, under Indian conditions of storage and use.

In comparing the cost of Vanaspati with that of refined oil, it must be noted that the cost of hydrogenation is only about Rs 25 per ton, but the excise duty on Vanaspati, because it is hydrogenated, is Rs 140 per ton.

Due to the general shortage of tin-plate throughout the world, one of the major problems now facing the Vanaspati industry in common with other processed food industries is the development of an alternative package to tin-plate.

The widespread practice of adulteration of ghee has frequently been blamed as due to the Vanaspati industry. This is most unfair. The answer to the problem is the exercise of the most vigilant control by the Public Health Authorities, and when adulteration is proved the offender should be prosecuted with the utmost rigours of the law. The suggestion that Vanaspati should be coloured in order to prevent its use as an adulterant is untenable.

The selling price of Vanaspati is so strictly controlled by Government that manufacturers are frequently in difficulty. The industry should be allowed to earn a reasonable return on its capital outlay.

INTRODUCTION

VANASPATI is a vegetable oil which has been refined, hydrogenated, deodorized, packed into hygienic containers, and cooled to a desirable consistency, in order to enhance its value to the consumer. In the early stages of its history it was known as vegetable ghee, which was indicative of its early role as a substitute for milk ghee. By now, however, Vanaspati has taken its proper place as a dietary fat independent of both ghee and vegetable oil. In fact the term 'Vanaspati' is now a household word throughout India and there can be few who do not fully understand what it stands for.

Vanaspati has been manufactured in India now for 21 years and this time of coming of age is a suitable one for looking back over the past achievements and difficulties of the Industry and of examining some of the problems which beset its future.

Historical

The advance of modern civilization, wherever it occurs in the world, brings in its train an increased standard of living and a demand for greater supplies of high-class consistent dietary fats than can be met from agricultural sources. As the industrial revolution progressed in western countries, the demand for solid fats, particularly for edible purposes, became acute. At first, this demand was met by an increased supply of lard and tallow from the herds of domestic animals which were raised on the newly developed plains of America. But even this source soon became too small for the increasing demand, and therefore at the end of the nineteenth century much experimental work was being conducted with a view to converting the abundance of liquid oils into useful solid fats. It was not long before a satisfactory method of effecting the hydrogenation of liquid oils to convert them into consistent fats was developed, and since about 1910 the oil hydrogenation industry has developed steadily throughout the world.

Soon after the first World War, India in her turn began to feel the need for greater supplies of consistent edible fats than could be produced by the ghee industry, and this need was met by imports from the already well-developed hydrogenation industry in Europe. In this manner Vanaspati first came to India, and it came to stay. Production in India started on a small scale in 1930, and in spite of various vicissitudes the Industry continued to expand steadily as the years went by. The following table illustrates the development of the Industry in India:

Year		*Sales in India of Vanaspati in tons*
1935	...	18,000
1936	...	22,000
1937	...	32,000

Year		Sales in India of Vanaspati in tons
1938	...	40,000
1939	...	51,000
1940	...	65,000
1941	...	84,000
1942	...	71,000
1943	...	87,000
1944	...	103,000
1945	...	134,000
1946	...	138,000
1947	...	96,000
1948	...	127,000
1949	...	153,000
1950	...	170,000

VANASPATI AND INDIAN FATS

The following table shows the estimated annual consumption in India of milk fats, Vanaspati and edible vegetable oils:

		Tons	Per cent
Ghee and butter	...	5,00,000	33. 3
Vanaspati ...	...	1,70,000	11. 3
Vegetable oils	...	8,30,000	55. 4
		15,00,000	100.00

It will be seen that only about one-sixth of the total amount of vegetable oil available is converted into Vanaspati and that the output of Vanaspati is only a third of the total output of milk fats. The Vanaspati Industry has frequently been faced with the problem of answering the criticism that the production of Vanaspati is injurious to the ghee industry. On the basis of a population in India of 351 millions, the total oil and fat resources available for edible purposes in India provide for a per capita consumption of only 9.6 pounds per year or less than ½ oz. per day. The

desirable nutritive minimum of fat consumption is about 2 oz. per head per day, so the people of India are always wanting more fat than is available for them. It is evident therefore that no one type of fat can harm the production of any other type, because there is ample scope for all types. Even if the production of ghee were to be increased many times, it is difficult to see how there could be any lack of demand for it. The price of Vanaspati is much less than that of ghee and only slightly greater than that of vegetable oils, and Vanaspati fills the natural gap in the nation's diet between the high priced ghee with its limited availability and the more freely available but less popular vegetable oil.

Vanaspati and Indian Agriculture

Vanaspati is derived from vegetable oils which in turn are expressed from oil seeds yielding oil cake as a by-product. Oil cake is used as cattle food, but mainly as manure. The greater the demand for Vanaspati, the greater the output of oil cake, which leads to a corresponding increase in the production of milk and other agricultural products. In this way, the production of Vanaspati fits in with the general agricultural economy of the country. The problem here is that too much oil-cake is used directly as manure and too little is used as cattle food. The fatty component of oil cake is virtually useless for manurial purposes. It is far better to feed oilcake to cattle who can digest the fat and much of protein and pass on the residue as dung, which is an extremely valuable manure.

It is unfortunate that the pressure of increasing population in this country is leading to an increased production of foodgrains and oil seeds and an increased mechanization of agriculture, with a consequent reduction in the production of animal feeding stuffs and of farm animals and therefore of milk products. The most efficient way of utilizing milk is to drink it whole, because thereby none of its valuable constituents are lost, and the tendency for this is likely to increase. The future trend will therefore be a reduction in output of milk fats and a corresponding increase in the demand for consistent edible fats of some sort. It is only Vanaspati which can fulfil this demand.

Vanaspati and Other Industries

The Vanaspati Industry, naturally enough, has a considerable influence on other Indian industries. Its relation with the oil milling industry is evident. It also affects the tin-plate industry, because of its large requirements of tin-plate for packaging. Then again, the Vanaspati industry makes considerable demands on the engineering industry for its specialized plant. In each case, the demand of the Vanaspati industry stimulates the other industries to greater and more efficient efforts. In particular, it stimulates the oil milling industry to extract oil more efficiently from oil seeds and thus to make greater use of the country's oil resources.

Vanaspati and Development of New Food Resources

It has been argued that the Vanaspati industry does not add to the food resources of the country but merely converts one form of food into another form. While this may have been true in the early days, it is not true at the present time. The edible fat industry is capable of converting low grade oils which are of little or no use in their natural state into high-class edible products. An example of this is cottonseed oil, which is of great potential interest in India. As it comes from the presses this oil is a thick opaque and almost black material with very little use. It can however be successfully refined to a pleasant pale yellow colour, but even the refined oil is unstable in a tropical climate. Hydrogenation, however, still further reduces its colour and converts it into a good fat for edible purposes. The American edible fat industry uses a large quantity of cottonseed oil. Full utilization of this material in India should be strongly promoted by encouraging seed crushers to import and use the specialized machinery required for delinting and dehusking cottonseed prior to pressing, which is essential for the efficient production of cottonseed oil; such plant is at present very rarely found in India. It is also necessary for Indian growers to produce a much better quality of cottonseed. The greatest care must be taken with cottonseed during all stages of growth, and in particular, during harvest time and during storage, in order to produce a good quality seed which

will yield a good quality oil. If this care is not taken, the seed deteriorates and the oil expressed therefrom is of such dark colour and poor quality that it is very difficult for even the most efficient refiner to make a good product from it.

It may also be mentioned that the Vanaspati industry helps to spread the nation's fat resources by converting oils of limited local appeal into a food of nation-wide acceptance.

Vanaspati and Vitamin A

It is generally conceded that India as a whole is deficient in the natural supply of vitamin A. In a country which is largely vegetarian, most people must get their vitamin A from vegetable sources or from milk fat. Foodgrains and oil seeds are unfortunately not rich sources of vitamin A. The tendency explained above for increased production of foodgrains and oil seeds has the additional effect of reducing the total supply of vitamin A which is available due to the reduced production of vegetables and of milk products. Vanaspati is an obvious vehicle for the assimilation of vitamin A, but up to the present it has not been fortified because the only readily available source of vitamin A was from whale or fish livers which would be repugnant to the bulk of the Indian people. Recently, however, the manufacture of purely synthetic vitamin A on a production scale has been successfully developed. Experimental work is in hand to determine the value of this synthetic vitamin A in Vanaspati and its stability under various conditions of storage and use. It is not too much to expect that all problems in this connection will soon be solved and that Vanaspati will fulfil a great role in the Indian diet as an extra source of vitamin A for a great number of people.

Nutritive Value of Vanaspati

It is not proposed in this paper to deal with this great and involved subject at any length. Such a subject is worthy of a symposium of its own. Briefly, it may be stated that criticism of the nutritive value of Vanaspati has been made on the following three main lines:

(1) That it is indigestible.

(2) That it does not contain certain valuable minor constituents which are in the parent crude oil, and that because of the treatment to which it has been subjected it does contain small traces of new and harmful substances.

(3) That it cannot be utilized by the consumer so well as the parent oil from which it was made.

A great deal of research work has been done on these problems in this country and in many other countries in the world. The sum total of all these researches is that hydrogenated fats have the same or greater nutritive value than the crude oils from which they are made, provided that they conform to certain specifications. The question of specification is dealt with later. In particular, it may be mentioned that the Government of India undertook the direction of a very large programme of research into the nutritive value of Vanaspati, as a result of which they were able to state that there is no deleterious effect produced by Vanaspati as compared with raw or refined oil.

Vanaspati *Versus* Refined Oil

The demand for a clean packaged fat of some sort is very great in these days when unscrupulous dealers so often foist goods of doubtful quality on to their customers. The argument is often heard that it is unnecessary to hydrogenate the oil to make Vanaspati, and that the demand for a clean packaged fat could be met by selling refined oil, which would save the cost of hydrogenation. Actually, the cost of hydrogenation is very little indeed; it amounts to approximately Rs 25 per ton, or just over 2 pies per pound, which is a very reasonable price for the consumer who wants Vanaspati. However, Government have imposed an excise duty on Vanaspati of Rs 140 per ton, which is one anna per pound, and which is nearly six times the cost of hydrogenation.

Packaging of Vanaspati

One of the characteristics of Vanaspati which appeals to its consumers is that it is mostly sold in small containers, the contents

of which reach the consumer in the same condition as they leave the factory. This container is almost invariably made of tin-plate. Tin-plate unfortunately is in very short supply, and the question of an alternative pack at a reasonable price is a very real problem which the industry has to face and which it has not solved. This is really one aspect of the very much wider problem of packaging food in general. People are more and more demanding that their food comes to them in a clean package, and much research work is required in order to evolve suitable packages which are clean, reliable, inexpensive, and which can be readily made from indigenous materials. Such packages are required for many other foodstuffs in addition to Vanaspati.

Vanaspati Quality Control by Government

Government have laid down a very strict specification to which Vanaspati must be manufactured. The specification restricts the maximum melting point of Vanaspati to 37°C which ensures that it is fully digestible, and other clauses ensure that the product is made from harmless raw materials and is properly refined. The specification also requires that Vanaspati should contain 5 per cent of sesame oil which reacts to the specific Baudouin colour reaction; this ensures that if Vanaspati is used to adulterate ghee, the former can be readily detected. The industry welcomes this specification as evidence of the intention of Government to ensure that processed foodstuffs are of the highest possible quality and benefit to consumers. It is hoped that such specifications will be made obligatory for many other processed foodstuffs. The problem is not only one of laying down a specification however, but its use must also be enforced.

The Vexed Problem of Adulteration

We now come to the vexed problem of adulteration. Most people are aware of the charge that is laid against the Vanaspati industry that its products are mainly used for the adulteration of ghee. Fewer people realize that the Vanaspati industry itself is frequently the victim of adulteration, in that unscrupulous persons

secure supplies of genuine Vanaspati tins and illegally fill them with substances which are very far from being genuine. It is very unfair to lay the blame for this largely on Vanaspati. Adulteration of ghee was practised long before the advent of Vanaspati. Nowadays most Vanaspati is sold in small packs which go direct to the consumer, and since the output of Vanaspati is only about one-third of the output of ghee, the Vanaspati which can be used for adulteration is very little indeed. More often ghee is adulterated with other substances such as animal fats or vegetable oils. The removal of one possible adulterant, by prohibiting the manufacture of Vanaspati as has often been suggested, will certainly not stop the adulteration of ghee.

The adulteration of ghee is really one small aspect of the general problem of adulteration which is unfortunately rife in this country. The only answer to this problem is not banning the production of possible adulterants, but the exercise of the most vigilant control of the quality of all products, which can be adulterated, by the Public Health Authorities. It is not sufficient to set up specifications; it is necessary to have regular samples analysed in public laboratories, and when adulteration can be proved then the offender should be prosecuted with the utmost rigours of the law. This is the only procedure which will make adulteration not worth while. It has proved effective in other countries, and there is no reason why it should not prove equally effective here.

Nowadays, it is frequently suggested that Vanaspati should be vividly coloured so that if it were used for the adulteration of ghee its presence would be immediately detected by the consumer. Such a practice could only make Vanaspati unacceptable to its consumers and place on them the responsibility for the detection of adulteration, both of which are most unfair. The consumer should not be inconvenienced, and the responsibility for detection of adulteration should lie with the Public Health Authorities. So far, in spite of diligent research, no suitable colour has yet been found for adding to Vanaspati which would be sufficiently vivid and stable while being also non-toxic. The addition of sesame oil to Vanaspati as a latent detector should be

sufficient, and nothing further is required. No country in the world has adopted visible colouration as a safeguard against adulteration.

Vanaspati Price Controlled by Government

The selling price of Vanaspati is controlled by Government, but the prices of the raw materials of the industry are not so controlled. In these days of rising prices generally, the selling price of Vanaspati tends to lag behind the increasing prices of raw materials with the result that manufacturers very often find it very difficult to make both ends meet. In order that the industry may progress and fulfil its function of service to the people, it is necessary that manufacturers should have a reasonable return on their capital outlay.

Conclusion

To sum up, the Vanaspati industry is one supplying a definite need and capable of making great contributions to the food resources of this country and to the health and happiness of its population. The industry also takes its place among other industries in the country, providing an outlet for some and stimulating the development of others. At this time of coming of age, it is hoped that the industry will solve all the problems before it and progress from strength to strength.


MAP OF
TRAVANCORE-COCHIN
BHARATA PUZHA R
CHALAKUDI R
PERIYAR R
MUNAMBOM
PERUMPAVUR
ALWAYE
ERNAKULAM
MUVATTUPUZHA R
MINACHIL R
KOTTAYAM
VEMBANAD LAKE
PERIYAR LAKE
MANIMALA R
PAMBA R
KAYAMKULAM
KAYAMKULAM LAKE
AYIRAMTHENGU
ACHANCOIL R
KALLADA R
ASHTAMUDI LAKE
NEENDAKARA
QUILON
ITHIKARA R
PARAVUR LAKE
ATTINGAL R
ANJUTHENGU LAKE
KATINAMKULAM LAKE
KILLI R
KARAMANA R
VELI LAKE
TRIVANDRUM
KOTHAYAR LAKE
NEYYAR
KOVALAM
VIZHINJAM
TAMBRAVARNI R
CAPE COMORIN
REFERENCE
RIVERS
CANNALS
LAKES
TOWNS
BOUNDARY

PRODUCTION AND PROCESSING OF FISH IN THE TRAVANCORE–COCHIN STATE

N. S. Varier

by

(*Central Research Institute, Trivandrum*)

Travancore–Cochin occupies an important place in the production of fish in India. It is estimated that about 1,850,000 cwts. of fish are hauled annually employing about 60,000 men in this maritime State. The author mentions the possibilities of developing the fishing industry in this State. Various methods of fish processing as practised in the State and also the possibilities of further improvement are described in this paper. Results of the work done during the last four years on moored-vessel fishing, use of model fish-curing farm, large-scale fish culture in ponds, artificial manuring and use of insulated boxes for transporting iced fish are described in detail.

AMONG the States of the Indian Union the maritime State of Travancore–Cochin occupies an important place in fish production. The existence of a long coast-line of 184 miles which is margined by a shore-water area of nearly 4,900 sq. miles including the rich and important fishing ground known as the Wadge bank, a chain of backwaters extending from the northern boundary to Trivandrum in the South with an area of 600 sq. miles, twelve important rivers with their tributaries accounting for a total length of about 1,570 miles, and a very large number of small ponds particularly in the coastal areas contributes to endow this region with a natural pre-eminence in fish production. In addition to these rivers and canals there is one region called Kuttanad which requires special mention. It is a low-lying tract of land adjoining the southern shore of the Vembanad lake and covers an area of nearly 180,000 acres. The average elevation of land in this region is 2–3 ft. below the level of water in the rivers and canals so that, except when under paddy cultivation, this

vast area is covered with 2–3 ft. of water and provides all the natural advantages for developing fresh water fisheries, on a scale unattainable in the rest of India. In these, various aquatic bodies which range from the fresh to the marine ones, a large variety of fishes breed and have their baiting.

Handicaps of Intensive Fishing

Against these natural advantages must be mentioned certain disadvantages which stand in the way of exploiting fully the vast fish wealth available in these waters. The sea-board is open and singularly deficient in harbour facilities, which means that ordinarily only small canoes and catamarans are able to fish. With these frail crafts fishermen conduct fishing only up to a distance of 5–6 miles from the shore because they are ignorant of even elementary principles of navigation and since their catch will be spoiled before they reach the shore if they go out longer. A second handicap of the sea fishing industry is that the fishermen are not in a position to go after shoals beyond certain limits or to visit some of the rich fishing grounds which are far off from the shore. With all these disadvantages it has been estimated that about 60,000 able-bodied fishermen land 1,850,000 cwts. of fish, which means that in spite of the handicaps a much larger quantity of fish is landed than in any other region in India.

Varieties of Marine Fish Caught and Their Nutritional Value

The different varieties of marine fish that are generally caught and their nutritional values are given in Table 1.

While the marine fish landed accounts for about 70 per cent of the total production, the lake fisheries of the State are also equally important. The lake fisheries provide the following: (1) Pearl spot, (2) Mullets, (3) Prawns. The nutritive values of these are given in Table 2.

Prawn Fisheries

About two-fifths of the total production of marine crustaceans come from the State of Travancore-Cochin (3). About ten varieties

of fresh water prawns and four varieties of brackish water prawns are common in this region. Most of them have the habit of migrating into backwaters during a period of their growth

TABLE I

NUTRITIVE VALUE OF THE VARIOUS MARINE FISHES

No.	Name of fish	*Moisture*	*Protein*	*Fat*	*Total Minerals*	*Calcium*	*Phosphorus*	*Iron (mgm.)*
		%	%	%	%	%	P_2O_5	%
1	*Arius sona* ...	63.96	14.81	19.19	1.72	0.165	0.164	9.22
2	*Tnymus thunnina* ...	64.7	21.0	12.25	1.36	0.184	0.113	2.43
3	*Lacturius lactarius* ...	70.6	19.00	7.45	1.72	0.194	0.158	29.30
4	*Sciæna spp.* ...	79.6	16.2	1.27	1.27	0.127	0.116	6.40
5	*Scoliodon spp.* ...	69.84	23.9	1.61	2.3	0.147	0.132	83.0
6	*Stolephorus spp.*	81.3	12.7	2.1	4.6	1.431	1.57	47.0
7	Pomfret ...	76.1	17.3	4.8	1.4	0.183	0.183	56.0
8	*Carana* spp ...	73.8	21.2	3.6	1.14	0.338	0.06	8.0
9	Cybium ...	71.7	18.36	6.4	1.28	0.396	0.176	33.0
10	Perch ...	68.7	21.8	2.6	1.63	0.274	0.128	89.6

TABLE II

NUTRITIVE VALUE OF BRACKISH WATER FISHES

1	*Etroplus suratensis* ...	71.5	17.6	2.35	2.89	...	...	17.8
2	*Arius spp.* ...	69.8	18.6	3.1	1.67	0.193	0.121	53.6
3	*Mugil spp.* ...	72.8	17.7	...	1.00	0.32	0.069	2.2

TABLE III

NUTRITIVE VALUE OF PRAWNS

1	Fresh prawns ...	76.4	17.2	0.45	1.5	...	...	...
2	Fresh dried ...	24.8	53.1	0.62	17.3	3.1	3.5	87.0
3	Beach dried ...	83.3	68.1	0.78	10.5	1.9	2.1	38.0

and the presence of extensive backwaters favours their growth. In the paddy fields of Kuttanad extending over hundreds of acres bordering the backwaters, only one crop is raised and after it is harvested, water from the backwaters and canals and a large number of prawns are let in every day by high tide. Sluices are provided to prevent them from flowing back during low tide. In these sluices short conical nets are fixed to fish out the prawns during ebb tide.

Prawns are an important item of export from these backwater regions, the annual amount from the Travancore region alone amounting to about 2,500 tons. They are processed for the market in one of three ways, (*a*) simple drying, (*b*) semi-drying, (*c*) cooking and drying. The nutritive values of the products that are marked are given in Table 3.

Marketing of the Catch

Though considerable quantities of fish are caught both from the sea and from the lakes, all this quantity is not distributed uniformly within the State. Owing to lack of facilities for the preservation and transport in the fresh condition, fresh marine fish is not generally available beyond a ten mile belt from the coastline and lake fishes beyond 10–15 miles from the lake areas. Nor are there any Ice Factories or Cold Storage facilities. The fishermen are therefore constrained to cure the bulk of their catches with salt since this is the only means of saving the surplus which is left over after meeting the local demands. But salted fish is not very popular among the local population and so the greater part of it is exported to places outside where it finds better demands. The most important centres of export are Ceylon, Burma and the neighbouring State of Madras. In 1948, from Travancore 1,23,000 cwts. of dried fish were sent to Ceylon and 72,000 cwts. to Madras and 97,000 cwts. of prawns to Burma. The most important items of export are prawns, anchovy, ribbon fish, tunny, sharks, perches, pomfret, and catfish. Dried anchovy and tunny are regarded as delicacies in Ceylon, dried prawn is favourite dish for the

Burmese and salted ribbon fish is very popular in Tamil districts.

Processing for the Market

As the only means of disposal of these large quantities of fish is to process them for export, various curing devices are adopted to preserve it for a long time. Methods of curing generally practised are: (1) simple drying, (2) dry salting, (3) wet curing and (4) pit curing.

(1) *Simple drying*

Certain small varieties of fish like the anchovies and sprats are simply dried in the open sun without the application of the salt till they become almost crisp. In this condition they can be stored for 7–8 months without spoilage.

(2) *Dry salting*

In this process the fish are split along the dorsal side and after removing the entrails, are arranged in layers inside a cylindrical cover of palmyrah mats with a liberal sprinkling of salt between each layer. The upper free end of the cover is then folded in and tightly bound with coir into a compact bundle, and immediately despatched to the markets. In this operation the fish is not dried at all, but the salt acts as a preservative, which arrests putrefaction for a limited time. The salt draws out some of the fluid contents of the flesh by osmotic interchange, which slowly dissolves the salt. From this, it follows that the keeping quality of the fish preserved in this manner depends on the time taken for the entire salt to be dissolved, and this does not exceed 5–6 days. Dry salted fish can therefore be distributed only within a limited range.

Since the success of dry curing depends on the preservative action of the salt by the formation of self brine which penetrates the tissues by osmotic interchange, it is not a very efficient method for varieties of fish, in which the tissues are very thick. The common varieties used for dry salting are butter fish, small mackerels and sardines, and even for these varieties the preser-

vation is not quite efficient. When the bundles are untied on the fifth or the sixth day the fish give off a very repulsive smell and sometimes they may even be infected with maggots.

(3) *Wet curing*

Larger fish such as horse mackerels, rock perches, skates, rays and catfishes are usually preserved by this process. The fish are split from the dorsal side and after removing the entrails, washed and immersed in concentrated brine for 12–36 hours—the period of immersion depending on the size of the fish. However, when very large fish are used for curing, the flesh is filletted before immersion. After removal from the brine they are dried in the sun for 3–4 days. If fresh fish is used, the resulting commodity is firm to touch and devoid of bad smell.

Wet cured fish can be kept in storage for 7–8 months and commands good market in Ceylon and most of the important towns in South India.

(4) *Pit curing*

This method is followed mainly in South Travancore for curing certain varieties of fish such as tunnies, horse mackerels, large ribbon fish, pomfrets, rays and skates. A large pit about 3½ feet in diameter and about 4–5 feet deep is dug up in the Yard compound and lined internally with palmyrah mats. Split fish are then arranged in layers inside the pit with liberal sprinkling of salt between each layer. When the pit is almost full the free edges of the mat are folded over and after covering the top with a few more mats, it is levelled up with earth. In this condition the fish remains for 3–4 weeks, during which time it is cured by the self brine formed as the result of osmotic interchange. At the end of this period the fish are removed and immediately bundled up with fresh palmyrah mats for despatch.

Defects in the Present System of Curing

From the foregoing account it will be seen that cured fish produced in the State is mostly of inferior quality owing to a

number of handicaps, the most outstanding of which are the following:

1. Curing is usually done when fish have already undergone partial decomposition. There is a considerable interval between the time of catch and the time of curing, during which period, exposure to natural conditions subjects the fish to bacterial action and autolysis. In other countries this is not a problem which presents any serious difficulty, since every precaution is taken to prevent decomposition from the moment fish are hauled overboard. Each fishing vessel is fitted with a large hold which in most cases is properly insulated with cork sheets. A supply of several tons of crushed ice is carried by each vessel and as soon as catches are hauled up they are thrown into the hold without much loss of time. By this method decomposition is arrested and the fish remains in the fresh condition throughout the voyage, till they are unloaded at different ports. In India the lack of such facilities is mainly responsible for the spoilage of fish before it reaches shore, and this in turn seriously affects the quality of the cured products.

2. Curing is usually conducted under unhygienic conditions and the possibility of contamination is a constant threat. Cleanliness and careful handling are fundamental principles of the fishing industry. Cleanliness consists not only in careful washing at every stage of transport, but also in scrupulous cleanliness of the storage chamber and the containers used for transport. Fish is a delicate commodity which if not carefully handled is likely to get damaged. But in India these principles are completely ignored. On reaching the shore the fishermen transfer their catches into wicker baskets encrusted with dirt and slime accumulated through repeated use, and on reaching the curing sheds the fish are heaped on the bar ground contaminated with sewage and human manure. Washing is not usually regarded as an essential necessity. The sheds used are often insanitary and the workmen trample over the fish with bare feet. In short every stage in the process of curing and packing is characterised by complete disregard of hygienic principles.

3. Packing for transport is very imperfect. The cured products are bundled up with ordinary palmyrah mats. This exposes the fish to risks of contamination and sometimes even to the attack of maggots. Dry salted fish packed in this manner exudes self-brine which drips from the bundles. As this drip gives out very offensive smell considerable difficulty is experienced by transporting authorities.

4. Lack of uniform supplies of fish is another important factor which seriously impedes the progress of the curing industry. For an industry to be progressive and steady it must have facilities for obtaining a continuous and regular supply of raw products but with regard to the fish curing industry this is not the case. Fishing is very irregular and catches are very uncertain. The fishermen do not go after the fish, endeavouring to discover fresh grounds or new shoaling areas. They wait till the shoals come into the inshore waters and only during these seasons do they get good catches, while during other months catches are very poor and inadequate.

5. The lack of facilities for drying fish during rainy months is as already indicated one of the most serious disadvantages of curing industry.

The movement of shoal fishes into inshore waters coincides with certain plankton intensities which in turn are controlled by salinity, rainfall, and direction of currents. During rainy months certain plankton organisms reach their maximum in their shore waters and fish which feed upon them migrate into these regions in large shoals. Thus, rainy months are the most favourable months for inshore fishing, but it is most unfavourable for curing. During such seasons, if for days together the sky remains overcast with clouds or if there are occasional showers or drizzles, drying will be altogether impossible and these adverse conditions have sometimes been responsible for very heavy losses to the curers.

When all these facts are carefully considered, it is not difficult to see why the cured fish produced in our country is of inferior quality, and why it is avoided by better classes of people. At present the consumption of the cured fish is restricted to ignorant

and illiterate labouring classes in industrial and plantation areas and there can be no doubt that some of the ailments endemic in such communities are due to the regular use of such unhygienically prepared and putrid commodities.

By-products of the Fishing Industry

The main by-products of the fishing industry that are utilized commercially are: (1) Fish manure, which is prepared in seasons of gluts by simple drying as well as by burying fish or the fish wastes in pits for 50–60 days and then drying, (2) Prawn shell manure, obtained as a by-product when prawns are cooked, dried and shelled during the preparation of prawn pulp, (3) Liver oils, especially Shark Liver Oil; and (4) Fins and air bladders.

Development Work Done

With a view to developing and improving the existing fisheries, schemes were sponsored five years ago jointly by the Governments of Tranvancore and India. These have been in operation for the last four years and the results achieved are briefly summarised below.

1. *Marine Fisheries*

Though deep sea fishing has been hitherto a failure in the Indian waters a fishing trawler named 'Chandrika' was tried for 'Dory fishing' in a modified form to suit local conditions in the Wadge area. In the strict sense of the term a 'Dory' is a small wooden craft carrying two men and capable of being nestled one inside the other when hauled upon the deck of a parent vessel when launched on the fishing grounds they set and haul their long lines independently.

But since dories were not available, ordinary dug out canoes were used and since the fishing grounds were not suitable for the use of long lines simple hand lines were employed. During each trip the parent vessel carried on tow 6–10 dug out canoes each manned by 8–10 fishermen. On reaching the fishing ground the canoes scattered in all directions within a radius of 1–2 miles

from the parent boat. At the close of each day's work, the canoes returned to the parent boat where the catches were cleaned and dressed and packed in barrels with salt or preserved with ice in insulated boxes. In this way fishing could be carried on continuously for 3 or 4 days at a stretch during each trip and thus avoid the necessity of returning to the shore after each day's fishing. But due to certain handicaps and the initial reluctance of the fishermen to prolong their stay at sea it was possible to fish only for 6–8 hours during each trip, lasting two nights and a day (two nights for the to-and-fro journey and one day for fishing). Even at this rate if it had been possible to conduct regular trips throughout the season the experiment would have been a great success. But due to lack of spare parts and consequent engine troubles, the interval between successive trips were often indefinitely prolonged with the result that though the season lasted four and a half months, it was possible to conduct only eight trips. The total quantity of fish caught during these trips was 24,517 lb. Out of this, 2/3 was given to the fishermen as their share and this when divided among the fishermen gave each of them 10–12 rupees per trip as against Rs 2–3, which is their normal earning.

No. of trips.	*Date*	*Wt. of fish (lb.)*	*No. of boats towed*	*No. of fishermen*
1	9–1–1949	1,656	8	64
2	17–1–1949	3,756	8	81
3	25–1–1949	3,180	10	102
4	3–2–1949	4,511	9	88
5	28–2–1949	2,826	8	80
6	27–3–1949	4,337	7	64
7	3–4–1949	888	9	90
8	5–4–1949	4,363	8	82

Due to long intervals between successive trips this experiment was not a success from an economic point of view, but it has successfully demonstrated the scope of moored-vessel fishing as an efficient means of solving some of the serious difficulties under which the fishermen are labouring at present and also as a means of fetching better income for their labours.

The difficulties encountered by the fishermen at present are:

(1) the long time taken for to-and-fro journey due to the slowness of their crafts; and

(2) the lack of facilities for preserving their catches at sea, which restricts their stay at sea.

These are serious handicaps which prevent them from earning the maximum returns for their labours. Invariably, they are able to fish only for about a few hours and even then their catches get partly spoiled by the time they reach the shore; but moored-vessel fishing helps them to get over these difficulties. Its chief advantages are: (1) it saves considerable time which is now wasted on the daily trips, to-and-fro; (2) it enables the fishermen to extend their operations far beyond the present limits; (3) it ensures preservation and curing before the fish begins to show signs of spoilage; and (4) it helps to increase production and thus ensures better returns to the fishermen for their labours.

2. *Model Fish Curing Yard*

To demonstrate the improvements that have to be effected in curing fish, a model fishing curing yard has been built at Cape Comorin. This Yard has been built on up-to-date lines with provisions for (*a*) cleaning and gutting shed; (*b*) curing shed; (*c*) storage and packing rooms; (*d*) smoke house; (*e*) hot-air-drying chamber; (*f*) water supply with overhead tanks; (*g*) drainage; (*h*) drying platforms; (*i*) manure depot. The drying platforms are of the type used at Grimsby in England. The use of such platforms will improve the quality of cured fish very considerably.

3. *Fresh Water Fisheries—Pond Culture*

To feed the innumerable ponds of the coastal areas with fingerlings, a nursery was started at Ayiramthengu in 1948, which was stocked mainly with Pearl spot fry. In the first year, trials were conducted in transporting and rearing the fry in thirty selected tanks at varying distances. When it was found that pearl spot could be successfully cultured even in fresh water, 250 more tanks were stocked in the succeeding year. During this work it was found that in one year's time half inch fingerlings generally grow to 6½–8½″ weighing on an average four to the pound. As a result of the experience gained the Department of Fisheries has undertaken to spread Pond Culture on a much larger scale and this work is now in progress.

Thus, it will be seen that fish culture which was hitherto practically unknown on a large scale has been successfully established on a small scale and the results so far achieved have convincingly demonstrated the economic possibilities of large-scale fish culture.

Along with the nursery at Ayiramthengu there is also a stocking pond having an area of 22 acres which was constructed by embanking brackish water of the backwaters. Sluices connect the pond with the backwaters and during high tide fish fry mainly Etroplus, Mullets, Chanos and Prawns enter. These grow in the pond and are fished at intervals. In the course of two years 27,375 lb. of fish have been caught from this area, proving thereby the potentialities of such embanked backwater fish farms. At Narakkal, near Cochin, a fine mulletry with an area of 11 acres had been constructed by the erstwhile Cochin Government, where the yield was about 10,000 lb. in 1948 giving average of about 900 lb. per acre.

4. *Artificial Manuring of Fish Ponds*

With a view to finding out the extent to which fish growth can be stimulated by adding to the water varying amounts of artificial fertilizers, a statistical field experiment was designed. Nine similar ponds, each 100 ft. by 25 ft., were specially constructed

by embanking the backwaters at Ayiramthengu. Each of these was sub-divided into four equal compartments by coir net partitions. Into each of these compartments 100 mullet fry having an average length of 3 inches each were put. The ponds were then manured with sodium nitrate and calcium superphosphate. The two fertilizers were administered at two different combinations (N_1, N_2, S_1 and S_2).

N_1—three times the nitrate in the control
N_2—six times the nitrate in the control
S_1—three times the phosphate in the control
S_2—six times the phosphate in the control.

The different combinations were N_1, S_1, N_2, S_2, N_1S_1, N_1S_2, N_2S_1 and N_2S_2 in the eight ponds with the ninth pond as control.

To study the growth rate of fish, nine sets of measurements of the length, girth and weight were taken at regular intervals on five random fishes from each of the thirty-six sub-ponds. Samples of planktons collected from these sub-ponds were also analysed.

The data thus obtained were examined statistically with a view to determining, (1) the fertilizer best suited for the growth of fish and (2) the rate of growth of fish in relation to the proportion of fertilizers.

It has been found as a result of analysis that artificial fertilizers are highly helpful in accelerating fish growth. Thus the treatment N_1S_2 and N_2S_1 increase the weight of fish by 6.26 gms per month, whereas under the normal lake conditions the growth is only 1.07 gms per month; in other words, it is possible to make the growth rate increase six fold by the above manure combinations.

5. *Preservation of Fish*

Perhaps the most fundamental problem in commercial fishing in these tropical waters where there is comparative abundance of fish, is the problem of preserving the catches and presenting it to the consumer without spoilage. Since even the farthest corners of the State can be reached within 48 hours from the coastline, this problem reduces itself to one of preservation for this time

interval. Properly iced fish is known to keep fresh for more than 72 hours and so the success of any endeavour for fresh fish distribution is dependent on the production of a cheap and efficient insulating material. As a result of many trials conducted here it has been found that cocoanut pith which is a waste product in the production of coir yarn from cocoanut husks has a thermal conductivity comparable to that of cork. It was also found that this material can be rubberized and compressed into blocks.

THERMAL CONDUCTIVITY OF COMMON INSULATING MATERIALS COMPARED WITH THAT OF PITH

Number	*Name of insulating material*	*Thermal conductivity in Cal. per sq. cm. per second for 1 c.m. thickness and 1°C difference of temp.*
1	Cocoanut pith ...	0.0001056
2	Granulated cork ...	0.0001069
3	Canec ...	0.0001248
4	Felt ...	0.0000907
5	Saw dust (mixed) ...	0.0001222
6	Mica powder ...	0.0002613

Using this material for insulation, a number of insulated boxes were made with a view to finding out their suitability for fish transport and distribution. The boxes were made of different kinds of soft and hard wood with a water-tight internal lining of galvanized iron sheet and one inch of rubberized cocoanut pith in between, for heat insulation. Each box was also provided with an outlet at the base for drawing out water when necessary and a sponge rubber lining between the box and the lid for ensuring air tightness.

For determining the relative efficiency of these boxes 25 lb. of ice were placed in each box and the rate of melting of ice and the total time taken for the entire ice to melt, were carefully recorded. The results obtained are given in the following table:

No.	Name of wood used	Size of the box	Weight of the box	Average amount of ice which melted every hour
1	Control (uninsulated) ...	24″ × 18″ × 14″	45 lb.	840 cc.
2	*Tectona grandis* (Teak) ...	24″ × 18″ × 14″	45 lb.	428 cc.
3	*Alstonia scholaris* (Pala) ...	24″ × 18″ × 14″	38 lb.	440 cc.
4	,, ...	27″ × 15″ × 15″	40 lb.	438 cc.
5	*Anthocephalus cadamba* (Venthekku)	24″ × 18″ × 14″	57 lb.	435 cc.
6	,, ...	29″ × 17″ × 14″	60 lb.	440 cc.
7	*Bombax Malabaricum* (Elavu) ...	24″ × 18″ × 14″	48 lb.	441 cc.
8	,, ...	27″ × 15″ × 15″	50 lb.	442 cc.
9	Mango wood ...	24″ × 18″ × 14″	52 lb.	440 cc.
10	,, ...	27″ × 15″ × 15″	54 lb.	444 cc.
11	All metal box ...	28″ × 18″ × 14″	60 lb.	448 cc.

From this table it will be seen that the type of wood used does not make any appreciable difference in the rate of melting of ice. The chief factor is the thickness of insulation and when this is constant the rate of melting of ice is also more or less uniform. Comparing these results with the rate of melting in the insulated control box of the same size the difference is quite evident. In the control box the entire ice is melted off in about 12 hours and in the insulated boxes the minimum time taken for the entire ice to melt is 26 hours.

In the next set of experiments 90 lb. of fish with 32 lb. of ice were packed in each box and it was found that at the end of 20 hours about 4½ lb. of ice still remained, and when the boxes were refilled with an additional 32 lb. of ice, at the end of 60

hours there were about 8 lb. of ice. With 80 lb. of fish and 40 lb. of ice the time taken for the entire ice to melt was about 32 hours. Even the farthest corners of Travancore could be reached within 24 hours by fast motor lorries from the important fishing centres and, moreover, even after the entire ice melts it takes about 4 hours for the fish to reach the normal atmospheric temperature. Thus, it is seen that for commercial transport of fish in Travancore-Cochin the minimum quantity of ice required for 90 lb. of fish is about 30 lb. of ice.

The author acknowledges his indebtedness to Dr C. C. John for the liberal use of his notes on the subject as also the progress reports of the Fisheries Development Schemes.

FUTURE OF FOOD PROCESSING IN INDIA

by

D. S. Bhatia

(*Central Food Technological Research Institute, Mysore*)

The Food Processing Industry of India is still in its infancy. In this paper the present status of the major food industries in India is discussed and an attempt made to bring out various problems that the industry is facing and the different factors that have hitherto hampered the growth of the industry.

Indian food industries comprise vegetable and fruit preservation, bakery, biscuit and breakfast foods, aerated water, sugar, confectionery and chocolate, vegetable ghee and oil seeds, malted foods, meat products and fisheries. We have not yet fully tapped the national resources. The fisheries industry in India is the most glaring example. There are great possibilities of fisheries development in our country. It has been estimated that in India we have been able to tap only 5-6 per cent of the entire fishable marine area. This industry becomes all the more important when we consider that fish is an important food in Bengal, Bombay, Orissa and Madras. In this paper the scope of the above-mentioned industries and lines on which expansion should take place are discussed.

There can be no future for food processing unless at the same time we develop the packaging industry in India. The position of tin-plate and glass industries in our country is not a very happy one and we must develop these two industries. In addition, paper and transparent film packaging materials must also be developed. A processed food may be very attractive to the eye, very acceptable to the palate and very wholesome from the nutritionist's point of view, but the job is not fully done till the product is adequately packaged so that it reaches the consumer in its best appearance, flavour and nutritional quality.

PROCESSING in broad terms refers to any treatment that a food material may undergo in its journey from the field to the consumer. The object of processing of food is five-fold:

(1) to remove toxic or inedible portions from a food material;

(2) to utilize the material to the greatest extent possible;

(3) to present to the consumer a food material in its best condition regarding flavour, appearance and nutritional quality;

(4) to conserve food in glut season and to make it available in all seasons of the year; and

(5) to discover new methods whereby new and diversified materials are prepared from the normally existing foodstuffs.

The science of food processing or in broader terms that of food technology is in a very highly developed state in countries like the U.S.A. and U.K. When a country has surplus food and the average standard of living is high, people become more fastidious in their choice of what they eat. Further, with education comes the nutrition-consciousness and the consumers want foods of garden-fresh quality. There, the role of food processing comes in and technologists endeavour to satisfy the demands of the consuming public. The example of the food industry in the U.S.A., shows how fastidious consumers are satisfactorily catered to.

In times of emergency when certain food materials become scarce the necessity of having substitutes arises. The examples are Mock Rice, made in U.K. and 'Risina', made in Australia, during the last World War. India is not producing enough food and as such processing of delicacies is not important at the moment because our immediate object is to make available staple bulk foods, the notable example being cereals. However, with the industrialization and modernization of India, the demands of processed foods are bound to increase. Indian food industry is in the process of development though in some fields hardly

any beginning has been made. Industries like milling, sugar, vegetable oil products and aerated waters are well on their way. Industries like bakery, biscuits, breakfast foods, confectionery and chocolate, fruit and vegetable preservation have already made a good start whereas fish, meat products and malted food products are still in a nascent state of development. It is beyond the scope of this paper to discuss in detail the future of all these industries but an attempt will be made to bring out various problems that the industry faces and how they could possibly be solved. I shall discuss, in particular, fish, meat and malted food industries and regarding the others I will make a brief reference here and there in the text.

I. Fish Industry

India's fisheries await development. Our average diet is deficient in proteins; and fish provides an excellent material to make up for that deficiency. There are great possibilities of developing fish industry in our country. We have 3,200 miles of coast line and 100,000 square miles of fishable marine area. It has been estimated that only 10,000 square miles have now been exploited and just 5–10 miles within the area has been touched. India produces 7 lb. of fish per person per annum whereas Japan produces 111 lb., Canada 109 lb., Denmark 35 lb. and the U.S.A. 35 lb. The minimum need of the fish eating population is 4 oz. per day for a person, which corresponds to about 90 lb. per head per annum.

Methods of Catching and Handling Fish

Fishing in Indian seas is confined to a narrow coastal belt because the equipment used for fishing is not of a type which can stand the rigorous requirement of off-shore and deep-sea fishing. Modern type of equipment such as ottertrawls, purse-seines, gill nets, traps etc., should be introduced into the fishing industry. Ice factories should be established at important centres along the coastal line so that the fishing boats go loaded with

crushed ice and bring back the catch packed in crushed ice. The fish, when landed, may be transported and packed in crushed ice, in large wooden boxes or barrels.

Methods of Preservation

Fish is preserved by salting, drying, smoking, pickling, canning and freezing. Frozen food industry has no immediate future in India for obvious reasons. Frozen foods have to be transported in such a manner that the material is not defrosted in transit. People must have in their homes deep freezers where they can store frozen foods till they are consumed. Needless to say, such facilities do not exist in our country at the present moment nor is there any likelihood of their being available in the near future. In India, drying and salting are the two commonly used methods of preserving fish. This industry must be organized on a scientific and hygienic basis. Canning of fish is in progress to a limited extent and this industry has good scope for development.

Future Research

Future research by Government agencies and private enterprise should be conducted along the following lines:

(1) better utilization of existing catches by suitable methods of preservation, transport and marketing;

(2) exploration and estimation of the magnitude of fisheries resources in India;

(3) better methods of catching fish by making use of modern equipment;

(4) utilization of fish waste for the manufacture of fish manure; and

(5) production of medicinal oil from shark liver and oily fish. A beginning has already been made in this field.

II. Meat and Meat Products Industry

The production of raw meat in India is carried on under the supervision of local boards and municipalities who have erected

slaughter-houses in their respective jurisdiction. No arrangements exist for the cold storage of meat either in the premises of slaughter-houses or of the retailers who obtain the supplies of meat at the slaughter-houses. The carcasses in whole or in cuts are kept exposed in shops. This is the condition of the raw meat industry. The canned meat and meat products industries are still in a nascent state in India. The meat products industry cannot become a major food industry in India as in Australia or the U.S.A.; still, the industry has enough scope to invite the attention of the Government who can help and improve upon existing conditions:

(1) by introducing obligatory meat inspection in slaughter-houses;

(2) by classifying the meat sold for quality and checking the quality by official testing; and

(3) by insisting on the provision of cold storage facilities in slaughter-houses and retail stores.

III. Malt and Malted Products Industry

The use of malt and malt extracts in combination with protein, vitamins and minerals for the preparation of tonic foods and in the manufacture of biscuits, breads and breakfast foods is widespread. Malt finds its use also in many pharmaceutical preparations. Government malt factory at Coimbatore is the only plant, producing malt extract and malt food. Of course, there are three breweries which produce raw malt for making beer only.

There is a considerable scope for this industry. We have, unlike many other industries, the raw materials and the necessary equipment which can also be manufactured in the country. The raw materials, barley, *cholam* and *ragi* are available in fair quantities. Barley is the most suitable for malting because it gives 45 per cent of its weight of malt extract as against 20 per cent in *ragi* and *cholam*. More factories on the pattern of Government Malt Factory, Coimbatore, should be started.

Auxiliary Substances Required in Food Industries

The auxiliary substances required for food industries include natural essential oils, synthetic flavours and edible colours. These industries are still to be established in India and should receive adequate attention in the extensive programme of development of food industries.

Packaging of Foods

Packaging is a part of food processing. A processed food may be very attractive to the eye, very acceptable to the palate and very wholesome from the nutritionists's point of view, but the job is not fully done till the product is adequately packaged so that it reaches the ultimate consumer in its best appearance, flavour and nutritional quality. It must be remembered that 'the proof of the pudding is in the eating'.

The packaging material industry is very highly developed in the U.S.A. and U.K. Paper and plastic sheets having grease-proofness, watervapour-proofness, water resistance, wet strength and capable of being heat-sealed have been developed. There is hardly any such industry in India. An Indian food processor draws upon tin-plate, glass and to a limited extent on paper for packaging his product. The plastic film industry has no past in the country. A limited quantity of cellophane is now being made. The position of tin-plate and glass is not a very happy one either. Tin is not produced in the country and the raw materials of suitable quality for the glass industry are in short supply. The percentage of breakages of the indigenously made glass bottles (specially bottles for aerated waters) is very high owing to their inferior quality.

The food processing industry has no future unless the problem of containers is solved. The cost of the package should not ordinarily exceed 10–20 per cent of the total cost of the product. The container question must receive the urgent attention of the Government and the producrs. Paper packaging materials must be developed and wherever possible tin-plate should be replaced by paper and fibre-board. We must develop fibre cans. Among

fibre cans we may have (*a*) all fibre can (fibre body with paper top and bottom) and (*b*) composite can (fibre body with metal ends). The quality of glass containers should be improved through use of better raw materials and modern engineering techniques.

Quality Control

What is quality control? Quality control assures the maintenance of uniformity to accepted standards. The standards may apply to:

(*i*) Food material—its edibility, nutritional and organoleptic quality.

(*ii*) Packaging—to ensure that the product will reach the ultimate consumer in the desired condition.

(*iii*) Handling of foodstuffs during processing in the plant.

(*iv*) Handling of food-materials during wholesale and retail distribution.

The mechanism of exercising quality control involves:

(*a*) Fixation of standards and specifications.

(*b*) Enforcement of food laws and suitable means to deal with defaulters.

Excepting a few products, there are no specific laws for the quality and production of food-materials. The Government must specify standards for both the raw and the finished products. The quality of the contents must be declared truthfully on the label on the package. This is very essential for assuring the buyer that he is getting his money's worth. In the interest of public health, the Government should see that the food is processed and distributed under rigid sanitary requirements. These measures will help to build up public confidence in processed foods.

Laboratory to Factory

From the time the idea is conceived to the time the product appears in the market, it is a long, time-consuming and by

no means an easy journey. The scientist in the laboratory works on his idea till he succeeds in giving it material shape. He then satisfies himself regarding the quality of the product as manufactured under laboratory conditions and on a pilot plant scale. Having done that he awaits the co-operation of industrialists. The producers must come forward and once they are convinced that the proposition is sound, when measured with the yard stick of economic feasibility, they should take the product on its forward journey to the ultimate consumer. There is a big and significant gap between the pilot plant and commercial production. The producers must seek the help of technologists and scientists in scientific institutions and they must come forward with money. They must finance the schemes and enquiries and must actively participate in the investigations and research necessary to bring the product from the test tube to the mouth of the consumer. There must be mutual understanding between the producer and the laboratory scientist. The scientists will provide the 'know-how' and the producers with their business talent will steer the product to its proper destination.

In conclusion, it may be said that the food industry has not had too bad a past, its present is good and it has a better future. With the modernization and industrialization of India the standard of living will be raised. With the rise in the standard of living, the demands for processed foods will increase. But this is the time when the industry should receive urgent and serious consideration at the hands of scientists, policy makers and industrialists. When the foundation is not strong, the superstructure is bound to be weak.

MANUFACTURE OF FOOD MACHINERY IN INDIA

by

Y. K. Raghunatha Rao

(Central Food Technological Research Institute, Mysore)

India has been entirely dependent on foreign countries for her requirements as regards machinery and allied parts. In the year 1949–50 India imported machinery worth over 10 crores of rupees, comprising all industrial and agricultural implements. On account of restrictions in the import of machines and machine parts, India has not been fully supplied with her entire requirements of machinery in this regard. Her requirement of machinery for food and food industries is much higher than the import figures indicate. It seems therefore that every effort should be made by all machinery manufacturers to manufacture food machinery. In the country there are 30 types of food industries requiring machinery like vacuum pans, dryers, filters, compressors, oil-crushing and refining plants, milling plants, sugar machinery, refrigerating machinery and miscellaneous equipment for dairy , bakery, confectionery and other food industries. It thus seems desirable that a survey of the requirements of food machinery in the country should be made in order to assess our annual requirements in this regard. The essential requirement for these industries are materials of construction, special types of steel, and control equipments. Until these can be manufactured in India we may encourage the import of such raw materials and instruments in a large measure. It seems obvious that the country has great potentialities for the development of this very important engineering industry. It is essential to carry out a survey of the technical equipment needed for food industries and obtain a comparative idea of the modern equipment and processes used in such industries in various foreign countries. It is also necessary that we

should get information from industrialists and food-processing firms regarding their requirements of machinery and machinery parts. In this connection the co-operation of industrialists and manufacturing firms is essential for the assessment of our requirements and manufacture of these machineries.

To increase food production, and develop the food industries in the land, we need more and more modern machinery. For growing our food crops and preparing them for consumption various varieties of agricultural tractors, harvesters, threshing machines, shellers and milling plant, hullers, polishers, flour mills, and sieving and grading machines are required. The oil industry, including Vanaspati, needs oil expellers, oil refining and hydrogenating machinery solvent extraction plant, dryers, and disintegrators. Food preservation and storage require refrigerating machinery, compressors, fans, condensors, refrigerants and electrical equipment. Sugar manufacture needs cane-crushers, mills, weighing scales, heat exchangers, clarifiers, evaporators, filters, vacuum pumps, rotary dryers, centrifugals, crystallisers, pumps etc. Other food industries such as dairy, biscuit, confectionery, canning, dehydration, yeast, malt, beverages, etc., need in addition to the above types other special machines like DeLaval Centrifuges, film evaporators, spray dryers, pasteurisers, ovens, vacuum cookers, autoclaves, air conditioners, graters, slicing machines etc. In addition, boilers, water filters, pumps and electrical machinery are needed. Hitherto, India has been dependent, for most of her machinery requirements, on imports from foreign countries. Since the last 50 years imports have been increasing year by year and they were reduced to some extent, during and after the last war, by the inability of exporting countries, chiefly U.K., Germany, Japan, the U.S.A., Canada etc. However, several hundred crores of rupees worth of machinery have been imported in these years. Imports of machinery of all kinds, in 1949–50, were valued at Rs 105 crores and in 10 months of 1950–51 at Rs 62.6 crores. Out of this, over Rs 10 crores are spent on food machinery. The needs of India, however, are many

times more and with every year, we shall need more and more machinery. On account of restriction on imports, want of dollar exchange and mounting cost of foreign machinery, the import figures are not truly indicative of this country's real requirements. Our imports in 1949–50 comprised agricultural tractors and implements valued at Rs 4.45 crores, sugar machinery valued at Rs 2.00 crores, refrigerating machinery valued at Rs 1.41 crores, oil crushing and refining machinery valued at Rs 47 lakhs, flour and rice mills valued at Rs 37 lakhs. Other miscellaneous machinery are unclassified and it may be estimated to total up to a value of over 10 crores of rupees annually.

India cannot afford to import such machinery for ever and it is a national duty to become self-sufficient as soon as possible. These machinery have to be made in such sizes and varieties as to suit local needs, the economic ability of our farmers and industrialists and the technological level of our workers. It is interesting to note that while the U.S.A. and Canada make over 80 per cent of the world's tractors, 40 per cent of their exports are mutual, Canada exporting light tractors, to the U.S.A. in exchange for heavy ones. India cannot use heavy tractors in her village economy. She has to manufacture light and simple and cheap tractors to suit her needs. In harvesting grains, the stalks are commonly threshed on the farms by the treading of bullocks and it is estimated that 3–5 per cent of the grain is left on the straw which is consumed by the cattle and is unavailable as food. Modern, simple threshers, separate the grain completely and thus will add 5 per cent to the yield of crops in India. It is of extreme importance to introduce modern threshers in the farms and thus increase food production. *Milling* experts state that a yield of 70–72 per cent dehusked grain is obtained from paddy by the use of shelling machines, whereas, in a large number of mills using hullers, there is a loss of 5–6 per cent rice and a decrease in the nutritive value of the rice by an indeterminate loss of bran. To avoid wastage of 5–6 per cent of rice, it is recommended to use shelling machines, of slower speeds, and paddy separators and special rubber rollers for polishing the rice to remove 4 per cent bran in order to obtain an acceptable

rice—comparable to the standard of hand-pounded rice. There are over 44 manufacturers of such rice mills in India who could make the desired machines.

Oil Industry. From her output of 7 million tons of oil-seeds, part of which is exported, 2 million tons of oil and 1.5 million tons of oil-cake are produced annually. For the industry, Indian machinery makers have made hand-operated screw presses, power driven rotary mills, and expellers. But the bigger expellers and hydraulic presses are imported. However, 7–10 per cent oil is lost in the cake and it is possible to recover this by solvent extraction and such solvent-extraction plants can be made in India. The result would be an increased output of 150,000 tons of edible oil.

Vanaspati. Nineteen plants with an output of 135,000 tons from groundnut oil exist and planned expansion to an output of 2 million tons from the suitable use of cotton-seed oil, require machinery like delinters, tempering machines, electrolytic hydrogen plant, refining, hydrogenating, filtering and cake drying machinery and catalysts, all of which India could and should manufacture.

Refrigeration Industries. Air compressors, blowers, condensors, refrigerants and electrical control apparatus are needed, and packaging machinery for all food industries have to be manufactured.

Manufacturing firms in India. There are over 945 general engineering firms in India, employing 155,000 skilled personnel, some already making machinery for biscuit, confectionery, sugar, canning, dairy and other food industries. They could naturally take up production on a varied and increasing scale, of the simpler machinery, at first. A dozen big firms in India, *e.g.*, in Bombay, Calcutta and Bangalore could take up manufacture of food machinery, requiring more engineering skill and facilities.

RECOMMENDATIONS

There is an urgent necessity for:

(1) assessing the requirements of several Indian food industries for various types of food machinery and equipment, by a survey of the technical equipments of existing food industries in India;

(2) obtaining information about the particular requirements of food manufacturers and industrialists in their present set-up and in their plans of future development;

(3) surveying machinery and equipment, used in similar food industries abroad, in order to plan future development in India;

(4) giving encouragement for the import of essential material of construction, of machinery, of control instruments and equipment for food industries, such as special steel, stainless steel sheets and tubes, copper and other non-ferrous machinery in sufficient quantities, till India could make these herself.

(5) inviting the co-operation of Indian and foreign firms engaged in the manufacture of such food machinery; and

(6) exhibiting the machines manufactured by Indian firms, on the model of the British Industries Fair, and stimulating inventions by prizes and medals for improved designs and subsidising machinery manufacture.

In these ways India has to develop her food machinery industry, which is necessary for achieving food self-sufficiency.

MANUFACTURE OF GLUCOSE FROM TAPIOCA STARCH

by

Y. K. Raghunatha Rao

(Central Food Technological Research Institute, Mysore)

It is estimated that India imports 5,000 tons of starch syrup and glucose valued at Rs 60 lakhs. Starch syrup is used largely in food industries such as confectionery, soft drinks, canning, baking, etc. Indigenous manufacture of glucose syrup from cheap locally grown agricultural products like tapioca is possible at an economic price. Starch factories could also be set up in conjunction with glucose manufacture. Pilot plant experiments at the Central Food Technological Research Institute have resulted in the production of good quality glucose syrup from tapioca starch. Present Indian manufacture of glucose from corn starch amounts to 600–900 tons per year. New factories for the manufacture of glucose could be conveniently set up by existing Indian sugar factories since much of the needed plant and equipment are common to both industries.

India is short of sugar in spite of 135 modern sugar factories, with an invested capital of Rs 40 crores, producing cane sugar. Especially, India imports large quantities of starch syrup, or liquid glucose for her confectionery industry and solid pure dextrose (*d*) for medical and other uses. India imports over 5,000 tons of starch syrup alone, valued at 60 lakhs of rupees, for several food industries and there is a potential demand for over 15,000 tons of glucose, solid and liquid.

With a view to supplementing our sugar resources investigations were carried out by Dr Desikachar in this Institute, under the direction of Dr V. Subrahmanyan, to utilize tapioca starch for the production of commercial lump-glucose and for liquid glucose. The investigation resulted in satisfactory samples being obtained and in the determination of necessary conditions for production of glucose, which could be used like *gur* or jaggery and containing 70 per cent glucose and 27 per cent maltose. It is an edible product, easily digested and is a readily absorbed

carbohydrate, for general and medical use. Soon after, pilot plant trials were undertaken resulting in the production of a clear glucose syrup and a white crystalline dextrose. (samples exhibited).* It is interesting to note that Java, the largest single producer of tapioca, grows 10–12 tons of tapioca per acre, whereas in Travancore, the chief tapioca-growing area in India, the minimum output is 3 tons per acre. Tapioca can be cultivated more extensively all over South India and by selection of varieties and manuring, can give higher yields. Statistics show that America imports annually over 170,000 tons of tapioca starch from Java. American production of corn starch is 800 million pounds or over 300,000 tons and her annual production of glucose is 669,000 tons, comprising 1,000 million pounds of starch syrup and 500 million pounds of pure dextrose. Starch syrup costs 4–5 cents a pound. India grows 1½ million tons of tapioca in Travancore. 5,000–15,000 tons of tapioca starch would be required for production of the starch syrup, in order to meet Indian needs for confectionery, beverages, canning, baking and other food industries. From pilot plant experiments it is apparent that, depending on the cost of the available raw material, which may be tapioca starch or flour or any other cheap source of starch, the glucose syrup would be produced at a cost of a few annas per pound giving a margin of profit to the manufacturer. The present cost of imported starch syrup is Rs 60 a cwt. The setting up of indigenous glucose factories along with starch factories could be as adjuncts to existing Indian cane sugar factories, especially as much of the equipment and machinery required is common to both the industries. It could be also a part-time production in the off-season of the sugar factory. Pure dextrose U.S.P. grade could also be made to meet the Indian demands. The resulting stimulus to extensive cultivation of tapioca would also be a welcome feature. It would be very desirable for Indian sugar factories, especially those producing confectionery, to put up starch and syrup factories to meet not only their own demand for confectioner's glucose, but also that of an expanding market for this commodity.

* These samples were exhibited at the Symposium—Ed.

QUALITY CONTROL IN FOOD MANUFACTURE

by

R. Rajagopalan and S. S. De

(Indian Institute of Science, Bangalore)

In the field of food processing, cleanliness, sanitation, and quality control are very important. Preservation of food is an art and recent researches have perfected it to a great extent. Apart from the scientific aspects of food-processing, honesty of trade is extremely important.

The legal aspects of food industry are very complicated and apply to all processed foods where the nutritional value is modified either by improved methods of manufacture or by enrichment. 'Nutritional improvement' is an expression used both for the preservation of the vitamins naturally present in fresh foods and for the addition of vitamins, minerals and proteins.

The addition of certain chemical substances must be carried out with the greatest care. Control of poisons or deleterious ingredients either present in the original foodstuffs, or in substances added as necessary during processing, to the permissible extent, are factors that require careful study.

The selection of the raw material, sorting into different grades, the preliminary operations, as for instance blanching, have to be carried out under controlled conditions —conditions that would preserve as much as possible the vitamins and other nutritious ingredients. Sterilization of the cans used in the canning industry and plant sanitation are extremely important since they determine the keeping quality of canned products.

In the fields of food preservation and processing, considerable scientific research and technique are needed. During recent years a great deal of work has been done on these two aspects and more especially in the United States, a certain amount of perfection has been attained. Considerable volume of literature has

accumulated on these scientific as well as technical problems. Preservation of food is indeed an art and recent researches have enabled the art to attain perfection. Apart from the scientific aspect of food preservation, honesty of trade is extremely important. It is hardly necessary to emphasise this point in places where food industries serve the basic needs of the community.

The Government of any country should therefore enact the necessary laws and form competent Advisory Bodies who could testify to the wholesomeness of the processed foods intended for the consumption of the public. It has been reported that nutritional improvement of foods presents many legal problems and it is therefore desirable that we in India should examine the processed foods that are already available in the country, so that the products come up to the standard that is required of them.

There are certain special foods which meet particularly the dietary needs of physical, physiological, pathological or other conditions including, but not limited to, the condition of disease, convalescence, pregnancy, lactation, allergic hypersensitivity to food, underweight and overweight; foods that supply the dietary needs of infancy and childhood; and foods that are used for supplementing or fortifying the ordinary diets with any vitamins, minerals or other substances possessing special dietary properties. By virtue of the special values of the foods quoted above, it becomes imperative that the consumer should know how exactly these foods have been processed, the special claims made by these foods, and the safety the consumer has in using them.

A food may be reported to have a certain amount of a particular vitamin or vitamins. When assayed by chemical methods, the quantities may conform to the amounts shown on the label. But the physiological availability of the vitamin is no doubt the governing factor in conferring the benefit on the consumer. Thus, the quality of the food so far as the vitamin availability is concerned would be seriously affected if the physiological availability is not taken into consideration. It may therefore be seen that factors such as these deserve careful consideration.

Again, when we take up certain foods reported to contain some amino acids for certain special dietary functions, we often

find the amino acids existing in a racemic mixture. This would mean that the acids are present in two forms, one form nutritionally available and the other non-available. Under these conditions it becomes necessary to know how much of the total amino acid content of the food is nutritionally available.

When dealing with processed protein hydrolysates which, under certain conditions, serve to supply the entire protein requirements, it is extremely important to ensure that such preparations contain all the essential amino acids in amounts sufficient to answer the daily requirements. In this connection special mention may be made of tryptophan which is fast being regarded as the first or second 'limiting' amino acid in nutrition. The interchangeable role of tryptophan and niacin, as also the special dietary function of pyridoxine, would seem to require careful consideration. A pre-digested protein food, therefore, should not only contain extra tryptophan but may also be fortified with the minimum pyridoxine requirements.

The total protein content of a food cannot, by any means, go to add to the nutritive value. The protein contents of soyabean and groundnut are very high, but the biological values of the two proteins are comparatively low. Suitable methods of processing would enable the proteins to be of greater benefit to the consumer. Undue claims regarding processing should hardly be made especially when no processing has been done at all.

The labelling or advertising of a food should be done in such a manner as to enable the consumer to get a correct idea of the food. If enrichment with vitamins and minerals have been done, the actual quantities of these used in addition to those already present in the food should be clearly stated. Honesty and fair dealing will best be promoted if such enriched foods as are made available to consumers serve to correct the deficiencies that normally exist and furnish a reasonable margin of safety. It is also desirable that the labelling of the food product is done in such a manner as to indicate the minimum daily requirement of the named vitamins and minerals supplied by such foods when taken in the specified quantity during the period of a day.

It is generally true that people are getting nutrition-minded.

Although this applies to India only to a very limited extent at present, it may not be long before we in India also come to regard processed foods with a fully aroused nutrition consciousness. Food processors should therefore adopt methods that are recent and most up-to-date and convince the consumer of the excellent benefit that could be derived by taking these foods though in small quantities. The cost of processed food should necessarily be kept as low as possible in view of the prevailing economic conditions. It is needless to say that any step in processing that unnecessarily adds to the cost of the food without a proportionate benefit should be avoided.

The legal aspect in food industry is an extremely complicated matter and applies to all processed foods, particularly to those where the nutritive value is modified either by improved methods of manufacture or enrichment. 'Nutritional improvement' is an expression conveniently used both for the preservation of vitamins naturally present in fresh foods and for the addition of vitamins, minerals and proteins. The use of natural vitamin sources in fortification or enrichment may add to the food product certain mineral salts or protein values at the same time.

In the processing of foods, the addition of certain chemicals is found necessary. There are quite a number of naturally occurring foods that have a 'poisonous' or 'deleterious' chemical present in them. In all such cases extreme care has to be taken in processing. Hydrocyanic acid present in Burma beans, some of the toxic substances found in muscles during certain seasons of the year, and the proteolytic inhibitor associated with certain legumes, particularly soyabeans, have all to be either completely destroyed or the concentrations brought down to well below the toxic level. In the case of chemicals that are required to be added in the processing, more especially when such a chemical is not having any direct adverse influence on the consumer, there is a need to regulate the addition. Such chemicals should be added just to the extent necessary and should under no circumstance form a good bulk of the processed food.

The addition of synthetic chemicals to processed foods has been on the increase. The types of chemicals added are (*a*) a wide

range of emulsifying agents, (*b*) anti-staling and anti-mould agents, (*c*) colouring materials, (*d*) antioxidants, (*e*) improvers and (*f*) a further group of materials added to overcome the shortage of fats and sugar. Apart from the toxic effects of some of these materials, it is necessary to determine whether the material introduced modifies the nutritive value. A substance of low nutritive value, such as paraffin, or of poor assimilability such as fatty acid esters of high melting point may be substituted for normal fats. The added chemical may interfere with the action of alimentary enzymes or with the absorption of materials of nutritional value. These chemicals may also cause changes in the gastro-intestinal function, thus bringing about nutritional disorder. A thorough study on the effects of these commonly added substances has to be made to protect the health of the nation. It is also desirable to improve the methods available for the determination of the toxic effects and also to carry out more detailed studies on the absorption and metabolism of the substances in question. Further knowledge and understanding of the gastro-intestinal functions as a whole and better methods for the accurate measurements of these functions are also needed.

In India, no branch of food industry has either developed to such an extent as to supply the requirements of her population or attained any reasonable degree of perfection worth mentioning. Above all, honesty of trade is possibly a matter which is seldom in currency. This, the basic requirement of any food industry, being the case, it would hardly be possible to expect any of them to develop or serve the nation.

While it is a fact that the biscuit and confectionery industries in India have considerably developed during the past few years, it is extremely regrettable that practically no attempt is being made to attach any importance to the nutritive value of the products. Quite a number of companies have placed their products in the open market in attractive and tempting cartons. These products have neither the aroma and flavour nor the appetizing effect which most of the foreign makes have.

In America, the paper and paper-board industry had supplied products that never caused a single outbreak of disease. On

the other hand they had made a striking contribution to decency and cleanliness in packaging and distribution of foods. The law, in spite of there being no complaint, started to control the supply of paper and insisted on microbiological tests before the paper could be used in food packaging.

In India, however, old newspaper is generally used for wrapping biscuits; but the outside carton is set out in a good style. The packets themselves are seldom moisture- or dust-proof. The biscuits lose the crispness and very soon rancidity is developed. How could quality and good name be kept up then?

The canning industry is still in its infancy. There are quite a number of precautions that are essential for the success of this industry. The selection of the raw material and the sorting into different groups form the essential preliminary operations. Besides these, a canning industry should bestow careful attention on the nutritive value of the product as also the 'quality' with reference to the shape, appearance and taste. The temperature and humidity conditions of manufacture play a significant part in determining the appearance and keeping quality of the finished product. Different foods need different atmospheric conditions and although in many cases air filtration is all that is necessary, it would be desirable to have air filtration in all cases. A simple device by which the air is filtered and rendered bacteria-free has been perfected.

The blanching operation is extremely simple and most essential and is practised in almost all cases. It has generally many functions: it ensures a uniform colour to the product when canned; it effects a partial shrinking of the outer pellicle thus obtaining a firmness in the finished product; it softens and removes the outer mucous coating; and it removes the entrained gas thus assisting in the closer packing of the products. Generally, over-blanching has more adverse effects than under-blanching. The blanching medium is also important and varies with the type of vegetable or fruit. In the case of peas for example, blanching is done in a weak citric acid solution to obtain the conventional pale pack. Thus, these operations are aimed at preserving as much as possible the vitamins and other ingredients of nutritive

value. The sterilization of the can and plant sanitation are also equally important in as much as they determine, to a large extent, the keeping quality of the canned material.

Problems of nutrition and technology of food would continue to interest man as long as the necessity to satisfy the pangs of hunger continues. It is a vital problem, a problem which will present itself in newer and newer aspects as years roll on. Large scale co-operative effort between the Government, the food industries, the food technologists, and the consumer is of the greatest importance and only then some measure of success could be achieved.

The Regional Laboratories in America take up schemes sponsored by food industries and the scientific personnel in charge of such schemes have always the guarantee of appointment by the food industries on the termination of the research project. Thus, the scientific workers are able to put their heart and soul into the problem and achieve a fair measure of success. In India, however invariably conditions are different. Seldom do industries offer scientific schemes. In the small percentage of cases that exist, the scientific workers have no guarantee of appointment. It is therefore not surprising to see that neither the industries on the one hand, nor the scientific workers and the public on the other, derive any benefit from such projects. It is high time that the Government realizes the wasteful way of such undertakings and set right matters to be of benefit to all.

TECHNICAL ASSISTANCE TO FOOD INDUSTRIES

by

V. A. Mehta

(Ministry of Commerce and Industry, Government of India, New Delhi)

The food processing industries in India are faced with a large number of technical problems which require fundamental research. The paper briefly deals with these with respect to several industries and suggests the examination of alternatives to cereals, use of anti-oxidants and the development of more nutritive varieties of bakery products. Similarly, the confectionery industry, breakfast food industries and industries producing other types of processed foods require considerable research to improve the quality of products. Research in food technology should be mainly devoted to improving the quality of present products, besides producing new varieties of processed foods.

THE food processing factories in India are often faced with a large number of problems which require fundamental research work. Standard processing techniques evolved in other countries have sometimes to be amended or re-adjusted in accordance with Indian conditions and quality of indigenously available raw materials. There is no doubt that the Central Food Technological Research Institute can contribute a good deal in this direction and thus assist the food processing units in the country.

By way of illustration, I would quote a few examples. The indigenous biscuit industry is concerned with the problem of the storage life of the finished products, notwithstanding the fact that many manufacturers pay foremost attention to packaging using special papers like plastic laminated, fibre-seal etc. The biscuit manufacturers would be glad to obtain full data regarding the use of suitable anti-oxidants like soya-bean lecithin, gallates etc., in order to retard the rancidity of the fat in the biscuits.

It would be worth while for the Central Food Technological Research Institute to carry on accelerated decomposition tests by irradiation on biscuits containing different types of anti-oxidants. I would lay special stress on exploring the possibility of using oats as anti-oxidants for the prevention of rancidity in fat-bearing foods. If oat-meal can serve this purpose it will have the double advantage of extending the mix.

At present, the Indian biscuit industry depends on imported wheat-flour for the raw material. But, sooner, or later, when India achieves self-sufficiency in the matter of foodgrains, we will have to determine which wheats are best suited for the biscuit and bread-making industries. The Central Food Technological Research Institute can start experimenting and collecting data in this connection. The physical properties of dough are affected by the type and quality of flour and other factors. It is worth while determining the relationship between the dough properties and the protein and starch contents of different types of Indian wheats. Such technological investigations on gluten proteins from the endosperm will be of great help to the manufacturers. A very 'weak' flour of soft nature with very little spring in the dough and with a low protein content of about 9–10 per cent is most suitable for the manufacture of biscuits while for bread-making a 'strong' flour with a good glutinous quality is preferable.

A good deal of investigation is essential in connection with fortification of biscuits and bread with nutritive ingredients like food yeast, soya-bean flour, malt, groundnut cake flour etc. This work would involve baking trials in a pilot plant scale oven. A few factories in India have recently started the production of breakfast foods like wheat and maize flakes. Due to the general shortage of foodgrains such factories are unable to function properly. The possibilities of using other subsidiary foods to feed such factories are worth exploring. Tapioca and other edible tubers can be stripped or diced and after gelatinization rolled into flakes. A factory at Poona did some experimental work in this direction.

Although wheat, oats and corn can easily be rolled into flakes, barley fails to respond to such a treatment on account of the

brittle nature of the grain. This requires further research work. There is a good demand for pearl barley and a similar demand would be the case with barley flakes if a suitable process could be worked out for the same.

Some time ago, the Food Industries Development wing of the Ministry of Commerce and Industry devoted attention to the production of vitaminised confectionery. Some literature published in this connection by M/s Hoffman-la-Roche U.S.A. was circulated to leading confectionery manufacturers in India. M/s Parle Products Manufacturing Co., of Bombay attempted to produce experimental samples of confectionery enriched with vitamins B_1 and C. They however found that the stability of these vitamins was very poor on account of high temperature involved during the processing of the confectionery. At present, India produces about 10,000 tons of confectionery per annum and even if a fraction of this could be successfully fortified with vitamins, it will be a creditable achievement. The attention of the Central Food Technological Research Institute is drawn in this connection.

The Institute can help the industry in the production of such items for which India had so far depended on imports. The indigenous canned meat industry has still to establish itself. The two bottle-necks in this connection are the high cost of raw material and lack of technical skill. The U.S.A. produces large quantities of canned meat products compounded with vegetables and other foods. There is a fairly large demand in India for such products. Besides this, studies on the production of meat juice extracts and concentrates for pharmaceutical purposes require further attention.

The Central Food Technological Research Institute can also be of great help to those food industries which are run on a small-scale basis. The assistance could be in respect of improving the processing technique as well as the plant and equipment. An indigenous sago-globules or Sabudana industry has sprung up near about Salem wherein tapioca is used as the raw material. But the culinary quality of the globules produced is far from satisfactory because the gelatinisation of the raw sago particles is carried out on steel plates heated on direct fire and is

consequently not homogeneous. The result is that on cooking the globules lose their characteristic globular structure. M/s Hind Chemicals Ltd., of Bombay have devoted considerable attention to this problem and they are attempting to use steam-heated pans for gelatinising the globules as they fall from the overhead sieve.

There are various problems connected with the oil industry which the Central Food Technological Research Institute can tackle. Some people are of the opinion that many crude oils contain *natural* anti-oxidants which protect the oils from oxidation. During the refining process, these substances are likely to be removed or destroyed and this explains why refined oils are much more susceptible to oxidation and tend to become rancid. We do not know how far the above theory is correct nor do we know anything about the properties of such natural anti-oxidants in crude unrefined oils. It is therefore worth while for the Central Food Technological Research Institute to carry on comparative studies on the activities of natural anti-oxidants or pro-oxidants in different types of refined and crude edible oils produced in India.

Besides the above, there are many types of *ad hoc* problems which could be tackled by the Central Food Technological Research Institute, a few examples being (*a*) incorporation of glycerine in certain processed foods to serve as both sweetening and preserving agent. (This is being done on a commercial scale in the U.S.A.) (*b*) production of extracts of different types of spices. (Instead of consuming spices in bulk and introducing unnecessary roughage in the system, one could conveniently use extracts of different spices. The extract of Indian coriander seeds will be a great boon to the South Indian cookery.) (*c*) improving the keeping quality of desiccated cocoanuts by using special packs like alkathene, pliobond etc. (*d*) studying the changes in the superficial texture of chocolate slabs on storage under Indian conditions. (Due to the rapid changes in the temperature during storage, the moisture gets accumulated and dissolves a small part of sugar and redeposits it on the surface as a grey film. Sometimes cocoa-butter in the chocolate is also liquified and comes to the surface, this being technically known as 'bloom') (*e*) studies on papain, obtained from papaya trees, in connection with its use as a meat

tenderiser. In the U.S.A. experiments have been carried out to tenderise meat like ham by injecting dilute solution of papain during pickling.

In the end I should like to suggest that the Central Food Technological Research Institute may determine the nutritive values of different types of processed foods produced in India especially canned products and Indian sweet-meats. At present very little information is available on this subject.

PROBLEMS FACING THE OIL INDUSTRY

by

G. M. Shah

(Hon. Secretary, The Deccan Oil-seeds Crushers' Association, Sangli)

This paper deals with the problems facing the oil industry in India. India is one of the largest producers of oil-seeds in the world. But, as regards the production of oil, the efficiency of some oil mills is not very high. The difficulties experienced by the industry such as export policy of the Government, inadequate transport facilities, Government policy of supporting village Ghani Industry, controls on oil-cake, etc., are briefly mentioned in this paper. It is suggested that Government should give serious consideration to these important points. This paper also suggests that Government should put a ban on the export of the oil-seeds yielding edible oils. As there is enough capacity in the existing oil mills, it is suggested that the installation of new mills should not be encouraged for the present and that the existing mills should improve their methods and produce the maximum amount of oil. Inter-State movement of oil-seeds, oil or oil-cake should be allowed as freely as possible. Controls on oil-cake may be discontinued, as these have adversely affected the oil industry.

Our per capita consumption of oil is very low. The remedy for this is to increase production and this can be done if the obstacles that are in the way of the industry are removed and the oil mills are placed on a sound footing.

India is one of the largest oil-seeds producing countries in the world. But except in the case of a few oil mills her oil industry has not attained sound stability. The problems facing the industry are complex and varied in character, and unless the Government and the crushers follow a sound policy the future of this industry will be far from satisfactory.

Oil is one of the important items of food. It is regrettable to note that while in countries like U.K. the *per capita* consumption of oil is about 65 lb., in India it is too low. It is therefore necessary to increase our production of oil and oil-seeds. In order to achieve this it is necessary that the existing oil mills should be made to work and produce more.

There are about 15,000 *ghanis* and 1,500 expellers in India. But the productive capacity of many remain unutilized for a greater period in the year. Many oil mills are working seasonally while some attend merely to decortication and to the sale of oil-seeds rather than to crushing. The reasons for this state of affairs can be briefly enumerated as due to:

1. the export policy of the Government,
2. limited financial resources of the rural oil mills,
3. inadequate transport facilities,
4. narrow margin of profits in crushing,
5. Government policy of supporting Village Ghani Industry in preference to oil mills.
6. want of uniform policy with respect to oil-seeds in different States, and
7. existence of controls on oil-cakes.

The above are the main obstacles in the way of the Oil Industry and if the Government gives them serious thought and consideration, they can be remedied, before it is too late. Some of the steps required to be taken for the promotion of the Oil Industry can be suggested as follows:

The Government should place a total ban on the export of oil-seeds, yielding edible oils. The export of oils may be allowed after full consideration of the crop position and domestic consumption. The shortage of raw material for the Oil Industry will thus be eased to some extent.

Starting of new oil mills should be discouraged for the present. Existing mills in the rural areas should be shown the ways and means of better extraction of oil from oil-seeds and should be made to work on scientific lines. The oil going to waste in oil-cakes can thus be saved.

Steps should be taken to increase transport facilities for raw materials as well as finished goods. More tank wagons should be made available for the transport of oil.

Supporting of Village Ghani Industry at the cost of the oil mills requires to be discontinued. While there is no objection to the continuance of Ghanis as Village Industry, it cannot be made to flourish at the cost of the mills. Village Ghani Industry and the mills should be placed on an equal footing and should receive equal treatment from the Government. All the facilities granted to the Ghanis should be extended to oil mills also.

Oil-seeds must be considered a central subject and there should be a uniform policy with respect to its trade throughout India. No restrictions on inter-State movements of oil-seeds, oils or oil-cakes should be allowed to be continued.

Controls on oil-cakes may be discontinued. These controls have adversely affected the oil industry. Different State Governments follow different policies with regard to oil-cake which is one of the important by-products of the Oil Industry. While some State Governments purchase 50 per cent of oil-cakes at fixed rates, the other Governments take only a fixed quantity of oil-cakes from different mills. Some State Governments have not fixed the prices of the oil-cakes at all. Many State Governments have fixed rates which are much below the prevailing market rates. Moreover, different Governments have fixed different rates for oil-cakes. As a result, crushers of one State have a good crushing margin while crushers in the other States have little or none at all. Removal of such controls will be beneficial to the Industry and Trade but even if they are required to be continued they should be uniform throughout the Republic and prices fixed should be just and reasonable.

Today the world faces a shortage of edible oils. Our own *per capita* consumption is too low. The only remedy for all that is to increase our production. This can be achieved if the obstacles in the way of the development of the Oil Industry are removed and the oil mills are placed on a sound footing. If the above proposals are considered seriously it will be of great benefit to this important industry.

REFRIGERATED PRESERVATION OF PERISHABLE FOODS IN INDIA

by

P. B. Mathur and K. Kirpal Singh

(Central Food Technological Research Institute, Mysore)

The fundamental scientific researches which have led to the development of the modern refrigeration industry are discussed.

The present position of the industry in India is compared with the development of refrigeration industry in other countries.

The need for a greater development of this industry in India is emphasized.

EVEN before the development of the scientific method for the investigation of various problems which has resulted in revolutionizing the whole human existence, the fact that perishable foods keep better in cold weather as compared to hotter periods was known to man. The development of the refrigeration industry has been helped, broadly speaking, by advances in the following two branches of science:

(1) Refrigeration Engineering, and

(2) Biological sciences like Agriculture, Horticulture, Physiology and Mycology.

In an ancient Chinese collection of poems, by Shih Ching, there are references to the use of ice cellars in 1000 B.C. The earliest recorded patent for a refrigeration machine was issued in Great Britain in 1834 to Jacob Perkins. This unit consisted of a hand-operated compressor, a water-cooled condenser and an evaporator contained in a liquid cooler. The unit was designed to be used with ether as a refrigerant. From this early discovery the refrigeration apparatus has been perfected to its present state when it is being used extensively in various capacities ranging from a household refrigerator to huge mechanisms employed in

commercial cold storages, ice-manufacturing units, commercial freezers and air-conditioning plants.

• Physiological losses in weight during cold storage are caused by (1) transpiration and (2) respiration. In general, far more weight is lost due to transpiration than respiration. Both these processes are decreased in their intensities by a lowering of temperature. Moreover, transpiration is also decreased by an increase in relative humidity. Refrigeration also inhibits the development of various decay organisms, thus curtailing the losses due to rotting. The pioneer investigations of F. F. Blackman, P. Parija, F. Kidd and C. West in England during the years 1928–30 led to the development of what is called the 'Refrigerated gas-storage'. The presence of high concentrations of CO_2 around fruits and vegetables tends to slow down the rate of respiration. In general, the higher the concentration of CO_2 the more the respiration rate is depressed. The effect of CO_2 can be explained on the basis of the Law of Mass Action, *i.e.,* the respiration rate is lowered because CO_2, one of the end products, accumulates. Similarly, when the amount of oxygen present in the atmosphere is reduced, there is a reduction in the rate of respiration. In refrigerated gas-storage, all the three factors, namely, temperature, CO_2 concentration and oxygen concentration are taken into account. This method of storage has given highly successful results with apples in the United Kingdom. These results have been profitably used by the industry for home storage as well as for transportation of perishable surpluses overseas.

• Mention may also be made here of a third method of preservation by low temperatures, namely, freezing. Frozen foods are common now-a-days in the U.S.A. and U.K., but in India this industry is still unknown, except for ice-cream. There is a great scope for the development of frozen food industry in India especially in big cities like Bombay and Calcutta. Distribution of the frozen foods within the city limits can be made possible through insulated or refrigerated vans.

• The losses of perishables like fruits, vegetables, meat, fish and eggs in a tropical country like India are naturally tremendous. India and Pakistan produce approximately 6 million tons of fruits.

This production provides a fairly good material for a balanced diet for our people, but in actual practice fruits are beyond the reach of even the middle classes in India. Further, India and Pakistan together produce nearly 500 lakh maunds of potatoes per year, out of which 85 lakh maunds, valued at 1½ crore of rupees are lost annually due to faulty methods of storage and transportation.

Development of the Cold Storage Industry in India

The cold storage industry in India has developed rapidly during the last 6–7 years, as is evident from the following data:

1946; 4 cold storages; capacity, 85,000 maunds approximately

1947; 2 cold storages; „ 42,000 „
(This decrease is due to the partition of India)

1948; 20	cold storages;	capacity	2,75,000	Maunds
1949; 44	„	„	6,00,000	„
1950; 57	„	„	7,70,000	„
At the present moment 100	„	„	16,00,000	„

It is evident from these data that the development of the cold storage industry in India has been much more rapid than even in some of the more advanced countries of the world.

At the present time the distribution of cold storages in India is as follows:

(1) U.P.—38
(2) Bombay—9
(3) Bihar—12
(4) Saurashtra—1
(5) Punjab—9
(6) Delhi—8
(7) Madras—5
(8) West Bengal—7
(9) Madhya Pradesh—3
(10) Rajasthan—3
(11) Madhya Bharat—3
(12) Orissa—1
(13) Jammu and Kashmir—1

Development of Cold Storage Facilities in India as Compared to other Countries

Although the development of cold storage facilities in India has been very rapid during recent years, yet the refrigerated space *per capita* is very small as compared to other countries as will be evident from the following data:

Country		*Refrigerated space per capita, c. ft.*
U.S.A.	...	5·7
U.K.	...	0·5
Australia	...	12·0
New Zealand	...	27·2
India	...	0·025

These figures tell a sad story so far as India is concerned. Further development of the refrigeration industry will constitute one of the most sound methods of solving our problems of food shortage and malnutrition.

GROUNDNUT AS RAW MATERIAL FOR FOOD INDUSTRIES

by

K. V. Giri

(Professor of Biochemistry, Indian Institute of Science, Bangalore, 3)

Attempts to utilize all available sources of food in the country during the present period of food scarcity have led to the finding that groundnut can be very profitably used for the manufacture of a number of highly nutritive products such as groundnut butter, groundnut milk, synthetic grains, predigested protein foods from groundnut and vitaminized groundnut seeds. Methods of manufacture of each product, its nutritive value, keeping quality and its importance in human nutrition are dealt with in this paper.

In recent years keen interest has been evinced, in several parts of the world, in groundnuts and the food value of its products. The introduction and large-scale production of groundnuts are under consideration in several countries. A groundnut boom is now on the way similar to the soyabean boom just before the war. Very recently a vast scheme for growing groundnuts on large scale lines on newly cleared virgin bush land was in progress in East Africa, which caught the public imagination in other countries. It is an Empire development of a kind which has never been tried before on such a large scale. This East African Government Scheme was run by Overseas Food Corporation. Although the scheme ended in failure, these undertakings bear testimony to the great utility of groundnut and its products as sources of human food. It is stated that the vast bulk of the world's groundnut crop goes into food products, and will probably continue to do so for many years to come.

The importance of the utilization of the available sources of food in the country at the moment of food scarcity and the

information gained by researches carried out in this country and elsewhere on groundnut and its utilization as human food have given rise to an increasing need for thoughtful application of the findings in human nutrition.

It is not intended to present a complete survey of the recent contributions made on the food value of groundnut, but rather to select some important developments which have influenced the knowledge of the uses and applications of groundnut as raw material for the manufacture of food products for human consumption.

The discussion will, therefore, chiefly centre on the four aspects of the manufacture of food products, in which groundnut is used as raw material namely:

1. Groundnut butter and milk;
2. Synthetic grains;
3. Predigested protein food from groundnut;
4. Vitamin-enriched groundnut.

Groundnut Products

Since raw groundnuts are unpalatable and unsuited for human consumption, it is impracticable and not desirable to recommend the consumption of raw groundnuts unless they are cooked, roasted or subjected to some form of processing so as to make it a more palatable and easily digested product. It is, therefore, desirable to devise suitable methods of converting groundnuts into products which are more palatable without affecting the nutritive and vitamin value of the raw product.

Peanut Butter

One of the well known and important products of groundnut is the one popularly known in America as peanut butter. It is produced and consumed in the United States in large quantities. This food product industry has developed to large proportions in recent years in the United States. It is stated that about 157 million lb. of groundnut valued at 16½ million dollars were produced in the United States in 1939. Now approximately

375 million lb. of groundnuts are being used annually in the manufacture of peanut butter. In fact, more groundnuts are used in this industry than for any other purpose.

Method of Manufacture

Peanut butter is prepared by grinding the roasted and carefully blanched groundnuts with the addition of salt. The quality of the product depends mostly on the grade and variety of nuts used. The best material should be used in the manufacture of the product, and the whole process should be carried out under controlled sanitary conditions. The selection of a suitable variety for the manufacture of peanut butter is very important. The varieties of groundnut most commonly used in the manufacture of peanut butter are the Virginia Bunch, Virginia Runner, the Spanish and the Southern Eastern Runner. Sometimes different varieties blended in suitable proportions are found to be of advantage for obtaining products of desirable quality. It is found that the use of a mixture of Virginia and Spanish nuts yields a smooth and fine flavour butter, as the Virginia absorbs the excess oil of the Spanish nuts.

The various steps involved in the process are as follows:

1. Roasting;
2. Cooling;
3. Blanching;
4. Cleaning and picking;
5. Blending;
6. Grinding; and
7. Bottling and packing.

Roasting

Shelled raw nuts are used for roasting which should be carried out carefully as the flavour and colour of the final product depends on proper roasting. The roasting is done in the roasting machinery similar to that used in coffee roasting. The operation is carried on at a temperature of 350° 400°F (176.7° 204°C) (which is considered the right temperature for roasting shelled nuts) for a period varying from 20 to 60 minutes, so as to obtain a uniform

product. The success of the operation depends on the proper regulation of temperature and the speed of rotation of the roasting machine.

Cooling

The rapid cooling of the roasted nuts is very important in order to obtain a perfect uniformity and to prevent some of the kernels from becoming too brown. This is accomplished by drawing cool air downwards through the hot batch by an exhaust fan, as it is being discharged from roasting cylinder into a cooling box, which has a false bottom connected with a suction line for exhaust. After cooling, the batch of kernels is carried to the blanching machines.

Blanching

Blanching which is the next operation, consists of the removal of the outer seed coats or red skins and 'hearts' or germs of the kernel. The presence of skins affects the appearance of the product, as well as its taste. The presence of skins in the final product imparts bitter taste to the butter. The presence of the 'hearts' of the kernels affects both the palatability and keeping quality of the final product. It brings about rancidity in the butter. These two constituents are removed by means of special machines known as blanchers. These are equipped with special devices to remove the germs and with suction fans to remove the red skins to a collecting chamber, leaving behind the clean halves of the kernels. The germs and the red skins are sold to the oil pressers as the oil content is sufficiently high to extract the oil profitably and dispose of the resulting cake for stock feed.

Cleaning and Picking

Immediately after blanching all the imperfect and unsound kernels are removed. This is carried out by means of a blast of air which lifts the lighter materials and leaves the kernals which fall into a receptacle. The lighter impurities which are carried along with the kernels are removed by subjecting it to suction, when the light material is carried away leaving the kernels

behind. Burnt peanuts and other foreign matter still present are removed by hand as the material passes on a moving belt.

Blending

As mentioned before, a better grade of peanut butter can be obtained by the proper blending of more than one variety of nuts. It is found that the Spanish nut which contains more oil when used alone gives a very smooth and oily product while the Virginia nut, having a lower oil content, gives a product lacking in smoothness. A mixture of the two in suitable proportions, however, gives a better grade product. The mixing is done at this stage, just before grinding.

Grinding

In the next operation the kernels are subjected to grinding process with the addition of salt. The grinding process should be carried out in such a way that the final product should not be either too fine or too coarse. If it is too fine the butter sticks to the roof of the mouth and if it is too coarse the butter has an objectionable gritty feel. For obtaining a uniform product, one of the most important requirements in the grinding operation, is to subject the mass to constant pressure. The mill which is generally used for this purpose consists of a heavy revolving screw in the centre of the mill which forces the crushed material at a constant pressure through a pair of grinding disks. The peanut butter comes out through the discharge spout in a continuous stream. Before grinding a small quantity of salt is usually added. The proportion of salt varies from 1 to 4 per cent of the weight of the butter. The salt is usually mixed with the groundnuts before they reach the grinder. For this purpose there is attached to the mill an automatic salt feeder.

The aim in grinding the butter is to break apart the minute oil cells without injuring the cell and liberating the oil. This results in obtaining a butter which is granular. On the other hand, if the grinding is carried too far resulting in the crushing of the oil cells, the product obtained is of a smooth, pasty consistency which allows the oil to separate.

Packing

The butter is then taken in jars and covered under a high vacuum. As rubber is slightly soluble in groundnut oil, it should not be used as cover for the bottles.

Keeping Quality

One of the difficulties encountered in the manufacture of peanut butter is the separation of the oil on top of the butter when allowed to stand for a few weeks, at room temperature. The fresh product will have very little oil separation. Various methods have been suggested for preventing the separation of oil:

1. Keeping at low temperature of 50°F or lower is the best and most desirable method of preventing oil separation; as the oil, being very viscous at lower temperatures, does not separate. Further the development of rancidity is considerably reduced.

2. Another method is the addition of 1–3 per cent hydrogenated groundnut oil or other solid fat and grinding the mixture into a homogeneous mass. The oil thus becomes too viscous for separation.

3. Subjecting the peanut butter in air-tight containers to steam pressure at 250°F for 15 minutes.

4. Addition of a small amount of glycerol, 1.5–2.0 per cent of glycerol usually giving the desired result.

5. The addition of a product to absorb the oil, such as ground raw peanuts, dried milk, sucrose, dextrose, oat flour, defatted soya flour or starch, has been suggested as one of the means of retarding oil separation.

6. It is stated that the addition of an aqueous dispersion of a wetting agent preferably lecithin, during manufacture, produces a peanut butter possessing very desirable qualities, such as a stable emulsion and less sticky and less rancid substance. This method is stated to be applicable to all types of nut butters.

7. Enzymic hydrolysis has been suggested as one of the methods of preventing oil separation. According to a recent U.S. Patent (U.S. 2,294,682; William, W. Moss., Jr.) a peanut butter relatively

free from tackiness and tendency to oil separation can be prepared by methods such as grinding roasted peanuts in the presence of an aqueous solution containing a proteolytic enzyme adjusted to pH. between 3.8 and 5 and digesting it at 95°–100°F for about 24 hours, and pasteurising the product at about 170°F.

8. The development of rancidity in peanut butter can be prevented by mixing it with crushed sesame seed (25 per cent). (S. Masher, U.S. 1816,338, July 28).

'Vegetable butters' from other oil-seeds such as sesame, soya-bean and the like may be prepared. It is, therefore, desirable to investigate the suitability of the methods described above for the manufacture of 'vegetable butters' and allied products from the oil-seeds available in this country. In addition to groundnut, sesame oil-seed would be an ideal and convenient material for the preparation of such articles of food as it is rich in calcium, protein and fat.

Food Value of Peanut Butter

Peanut butter is a very concentrated food containing proteins, vitamins and minerals. It is a very palatable and easily digested product. It is generally used in sandwich fillings, and for the preparation of soups, salads, cakes, omelets, etc. In the following table the figures for the chemical composition of peanut butter are given:

Moisture ...	0·87-3·7% (Average 1·74%)
Ash	1·91-3·18% (Average 2·37% dry basis)
Oil	39·45-52·34% (Average 46·7% dry basis)
Crude fibre ...	2·67-4·31% (Average 3·34%)
Protein	54·64-62·45% (Average 58·65% dry meals, which is equivalent to 30·06% on the basis of the whole butter)
Carbohydrates ...	17·0% (Average)
Calcium	0·034-0·048% (Average 0·041%)
Phosphorus ...	Average 0·404%
Iron	0·00167-0·00198% (Average 0·00187%)

Vitamin B_1	...	324-450 micrograms per 100 gms (Average 380 micrograms per 100 gms
Riboflavin	...	118-155 micrograms per 100 gms
Fuel Value	...	2825 calories per pound

Groundnut Milk

The possibility of preparing vegetable milk from groundnuts similar to soyabean milk, which takes the place of cow's milk in China, has been investigated in our country. The results so far obtained indicate that it is possible to prepare milk from groundnut which compares very favourably with soyabean milk in chemical composition.

Preparation

The groundnut kernels are soaked in twice its quantity of water at room temperature for an hour and a half, the water being changed every half an hour. The seed coat is removed by rubbing the seeds with cloth. The material is then ground in a convenient grinder and the pulp is treated with water equal to 2½–3 times the weight of seeds. After stirring the mass vigorously for 5–10 minutes, it is filtered through cheese cloth. The residue is again treated with the same amount of water and again filtered. The use of slight warm water yields a better emulsion. About 6 lb. of milk are obtained from 1 lb. of seeds.

Properties

The milk is found to have raw taste and to give groundnut oil odour. The milk can be heated and boiled without any effect on the emulsion properties of the milk, and precipitation of proteins. Heating will destroy the raw taste and odour of the milk to a slight extent. The boiled milk is found to keep well for 48 hours without any deterioration.

The milk can be converted into curds by the usual methods. The curd is almost indistinguishable from buffalo milk curd, in taste and sourness. Many milk preparations, such as ice-creams, *Khova, Basundi*, etc., have been prepared from groundnut milk.

The residue after the preparation of the milk, constituting about

25 per cent of the groundnut used, can be dried in the sun and used as a thickener in soups and in the preparation of *chutneys*, *vadais*, etc.

SYNTHETIC GRAINS (*Rice Substitutes*)

Researches have been carried out recently in the Central Food Technological Research Institute on the production of synthetic grains, having more or less the same chemical composition as, and somewhat superior in nutritive value to, natural rice. One of the important ingredients used in the preparation of these grains is groundnut cake flour.

Method of Manufacture

The process consists in mixing tapioca flour and groundnut cake flour in the proportion 90 parts to 10 parts and kneading the whole mass into a dough by adding 70–80 parts of water. The dough is then subjected to a process of granulation by rubbing it over a wire mesh screen (6–8 to an inch) and shaking the coarse particles thus obtained in trays with canvas or metallic (aluminium or galvanized iron sheet) bottoms. This results in the formation of round grains. The wet grains are then subjected to a process of gelatinization by roasting in rotating drums at 200°–210°F. This process takes 8–10 minutes, and the gelatinized grains thus obtained, are pale yellow in colour, and rubbery when pressed between fingers. The gelatinized grains are then subjected to drying and roasting. The grains are first dried in a cabinet, in a current of hot air (60°–70°C) and roasted in a roaster for 2–3 minutes. Sun-drying also may be adopted. The grains thus obtained are yellowish brown in colour, with agreeble flavour, and desirable cooking qualities.

It is estimated that the synthetic grains prepared in the above manner may cost 3–3½ annas per pound.

The process has been successfully worked out on a pilot plant scale and consumer trials with the preparations made out of these grains have shown that they are generally acceptable.

The rice substitutes prepared from a mixture of tapioca flour (70 parts), groundnut cake flour (20 parts) and rice or wheat (10 parts) possess a higher nutritive value than rice.

These investigations have shown that it is possible to prepare grains from tapioca, sweet potato and maize flour admixed with groundnut flour, as substitutes for rice. The keeping quality of these synthetic grains and methods of storage, however, remain to be investigated.*

Use of Groundnut Flour as Human Food

The preparation of edible flour from groundnut cake and its utilization for human consumption has been the subject of intensive study in India and under the present conditions the problem is gaining renewed and added interest. Groundnut flour can be obtained from raw or roasted groundnuts or from groundnut cake, the residue left after pressing out the oil in the oil press. During the last war and even before that, attempts have been made to use the cake flour in some form or other, for human consumption. The experience of several workers interested in the utilization of this material as human food, have shown that this material can be most effectively employed in the protein fortification of foods commonly used in this country.

Attempts to use groundnut cake flour in some form or other for human consumption were made in India in the early years of the present century. As early as 1917, Dr Mackenzie Wallis evolved a food for us as an admixture with cereal flours for bread, biscuits, and other forms of human food. He called it 'Nutramine', which was similar to a German groundnut preparation called 'Nutrose' (Vol. IV and VI, *Indian Jour. Med. Res.*). The groundnut protein is, however, deficient in tryptophane, which can be supplied by the addition of skim-milk powder or of casein, which is solubilised by adding 1 or 2 per cent sodium carbonate. The preparation 'Nutramine' contained 84 parts of groundnut meal, 14 of dried milk and two per cent bicarbonate of soda. The flour was found to keep well and it was considered to be very good as an admixture with cereal flours for bread, biscuits etc., with soup or with hot milk as an invalid food. Hitherto, it is

* These have now been investigated at the Central Food Technological Research Institute, Mysore.—Ed.

stated, groundnut cake had been used as human food only by the Germans and Nutramine was expected to take its place in India.

It is only very recently, when we are faced with food shortage in the country, that interest in groundnut cake has revived and the possibility of using groundnut cake flour as such or mixed with flour from cereals, millets and tubers, for human consumption has been considered. Experimental trials have shown that a mixture containing 40 parts of groundnut cake flour and 60 parts of maize flour can be used for making various culinary preparations. Other cereals or millet flours can also be used for mixing with groundnut flour.

Preparation of Groundnut Flour

Groundnut cake is usually obtained from oil mills and contains 7–8 per cent oil. The oil content can, however, be reduced to 1 or 2 per cent by subjecting it to solvent extraction.

In preparing the flour which is intended to be used for human consumption, some special precautions have to be observed. There is the common belief that groundnut cake produces diarrhoea. It is due to the fact that the cake is adulterated with castor oil and fragments of the outer shell and hard 'grit' which is generally added to get a better 'grip' in the expeller. The oil press should, therefore, be used exclusively for groundnut and should not be used for pressing castor oil. Clean kernels should be used removing all the impurities such as shell, husk and stones. If the skin is removed from the nuts before pressing, the cake obtained is whiter in colour, without any smell.

Heat treatment is desirable in order to reduce the moisture content and at the same time improving the taste and destroying the enzymes which are responsible for spoilage during storage. The keeping quality of the flour is very much improved by reducing the moisture content to 4 per cent. The oil content also should be reduced, as the oil in the cake develops acidity. The heat treatment should not exceed 100°–112°C for about an hour in order to prevent the destruction of vitamins to a considerable extent, and development of colour.

The chemical composition of the cake usually obtained by pressing in the mill is given below:

CHEMICAL COMPOSITION OF THE CAKE

	per cent
Protein	55·50
Carbohydrates	25·28
Fats	7·8
Moisture	6·8–7·5
Minerals	4
Ash	3·7
Crude fibre	2·1
Calcium	0·074
Phosphorus	0·556
Iron	0·0033

USE OF GROUNDNUT FLOUR IN BAKING

Investigations carried out for the utilization of groundnut flour in the baking industry, have shown that satisfactory bread, biscuit, cookies and cakes can be made from mixtures containing groundnut flour and wheat flour. Bread can be made from white flour containing up to 25 per cent groundnut flour and from 85 per cent whole wheat flour and 15 per cent groundnut flour. A slight decrease in the whiteness of the crumb with increasing percentage of groundnut flour added to white flour and a decrease in the volume of the loaf are observed. A slight decrease in the volume of the whole-wheat bread has been observed by the addition of groundnut flour. No change was, however, observed in the grain and texture.

GROUNDNUT CAKE AS RAW MATERIAL FOR THE MANUFACTURE OF PREDIGESTED PROTEIN FOODS

In recent years rapid progress has been made in several countries in the manufacture of protein hydrolysates and flavouring materials from proteins. The use of protein hydrolysates in food industries

consists in their incorporation into food products with the object of increasing the nutritive value and improving their flavour.

The use of protein hydrolysates for incorporation into food products was developed for the first time in the Far East at the beginning of the present century and it is stated that the first commercial use of hydrolysates was made in China and Japan about 1908. Since then rapid progress in their manufacture has been made in England and the United States.

The raw materials used for the manufacture of protein hydrolysates usually consist of protein-rich materials such as casein, glutens and meat. Sometimes the raw materials are blended to give the desired flavour to the product and supply the necessary amino acids in the final product to make it nutritionally satisfactory.

One of the important advantages of the manufacture of protein hydrolysates consists in the utilization of rich sources of protein, which are otherwise unsuitable for human consumption, such as groundnut cake. Such materials are always associated with undesirable materials, which cannot be consumed without any further treatment. It is possible to convert such materials into protein hydrolysates containing most of the essential nutrients present in the original materials. These protein hydrolysates may be usefully employed for fortifying foodstuffs with a highly concentrated source of predigested protein.

Method of Manufacture: Protein hydrolysates can be prepared by hydrolysis of the protein contained in the material by (*a*) enzymic, (*b*) acidic and (*c*) alkaline hydrolysis. It is not proposed to discuss in detail the advantages and disadvantages of these methods. The method of hydrolysis by enzymes has many advantages from the point of view of the nutritive quality of the final product, as the amino acids are not destroyed during the process. The process of enzymic hydrolysis is, however, slow and does not go to completion and consequently the final product contains large proportions of peptones and polypeptides. Further, special precautions should be undertaken in order to prevent bacterial contamination during hydrolysis. In alkaline hydrolysis considerable destruction of the nitrogenous products occurs

yielding a product with unpleasant flavour. It is, however, found that the destruction of tryptophane and humin formation is smaller compared to acid hydrolysis.

The method of acid hydrolysis is generally employed in the manufacture of protein hydrolysates. Hydrochloric acid is generally used for hydrolysis, though sulphuric acid also can be used, when a hydrolysate free from salt is required. The flavour of the product obtained by hydrolysis with sulphuric acid is found to be inferior to that obtained by hydrochloric acid hydrolysis. Further, the use of non-volatile acids involves problems of corrosion. After hydrolysis the acid is neutralised to a pH of 5.0–6.0, and after filtration to remove the insoluble residue, the filtrate is concentrated.

The final protein hydrolysate is usually obtained in the form of a thick paste containing 12–15 per cent of water, 40–50 per cent of salt, 4.75–5 per cent of nitrogen and 3.7–4.0 per cent of amino nitrogen. The protein hydrolysates are also prepared in the form of spray-dried solid material containing about 50 per cent of salt and 3 per cent of water.

The protein hydrolysates are generally prepared from casein or meat. In view of the present scarcity of animal products, it is necessary to find adequate alternatives. Increased interest has recently developed in the nutritive value of plant proteins which may practically replace or substitute proteins of animal origin. Various oil-bearing seeds can be used as a source of protein for the manufacture of protein hydrolysates. Groundnut cake is useful from this point of view. Predigested protein food can be prepared from this seed cake for human consumption. A process has been developed in these laboratories for the preparation of predigested food from groundnut cake. The process consists in suitably treating the groundnut cake powder by enzymes, such as papain and concentrating the product to a suitable consistency. This method of obtaining the predigested protein food results in a product containing the bulk of proteins, vitamins and minerals originally present in the cake. The product is palatable, which aids in its general acceptance. The residual material, obtained after extraction of the digestive protein, contains some quantity

of undigested proteins, carbohydrates and minerals which could be used as a stock feed after suitable drying. The product so prepared from groundnut cake resembles, in several respects, yeast extracts such as marmite.

These predigested protein concentrates from groundnut cake offer a good substitute for meat and meat products. Experiments with other oil seed cakes have shown that they could be processed in the same way as groundnut cake to yield quite palatable concentrated digests which are easily assimilated. Sesame cake has the additional attraction that it is naturally very rich in calcium. Cotton-seed hydrolysate is also a pleasing product with a good taste and flavour. A suitable mixture of groundnut, cotton-seed and sesame flour, predigested and concentrated would certainly turn out to be a first class article of food.

Vitamin Enriched Groundnut

One of the most serious nutritional faults in India is the deficiency of vitamin B_1 in our diet. A large proportion of the total food calories is taken in the form of refined foods such as rice which contains little B_1. The vitamin B_1 deficiency will be further aggravated by the failure of cereal crops and the acute shortage of foodgrains and consequent reduction in cereal ration. The health and efficiency of the nation is considerably impaired as a result of the deficiency of B vitamins in the diet. Diseases associated with vitamin B_1 deficiency will be on the increase unless immediate action is taken to combat the deficiency.

Some practical measures to combat the vitamin B_1 deficiency in India have been suggested from time to time. These include (1) undermilling of rice, (2) consumption of parboiled or 'converted rice', (3) artificial enrichment of rice with vitamins, (4) incorporation of the vitamin in the salt supply, and (5) distribution of vitamin tablets. It is doubtful whether undermilling can be relied on to improve the nutritive quality of rice owing to lack of proper and easy methods of controlling the degree of undermilling and the bad storage quality of the undermilled rice. Further, the public seem to prefer white rice. Parboiled rice, which is favoured in certain parts of India, is viewed with

disfavour by a large section of people in other parts of India. The unhygienic methods adopted in its preparation, the disagreeable smell and religious sentiments have stood in the way of its introduction throughout the country. 'Converted rice' which is also a form of parboiled rice manufactured in America by an improved and mechanised modification of parboiling process may not find much favour, as the small nutritional advantages gained by the consumption of this rice may not justify the cost needed to introduce such an intricate technical process in India. Fortification of the vitamin in salt was found to have no special advantage as the vitamin is not stable in the salt under tropical conditions. Distribution of vitamin tablets is now being practised in all countries. Whilst it may be predicted that the distribution of vitamin tablets will tend to improve the nutritional status of the population; nevertheless it will be difficult to persuade everyone, particularly school children in rural areas, to consume vitamins, in the form of tablets which may not be taken as readily as groundnut or similar natural food materials (which they are quite familiar with) enriched with vitamins. It is difficult for one to consume everyday some tablets which are considered by most people as medicine. In view of the various limitations of the above measures suggested to increase the vitamin B_1 intake of the population, it seems desirable to explore other possibilities of making available vitamin B_1 to all classes of people in the country.

With this object in view, our attention was focussed on groundnut which is an economical and easily available nutritious food material, with a view to enriching it with more vitamin B_1 and our efforts to produce groundnut containing enough vitamin B_1 to meet the daily requirements of man when consumed in very small quantities (10–20 grams) have met with success. A process for enriching groundnut with vitamin B_1 has recently been developed by the author which can be immediately adapted to large-scale production without much effort and cost. The enriched groundnut is found to be more palatable and attractive than the unprocessed kernel. It contains 100–200 micrograms of vitamin B_1 per gram of kernel. Products having uniform potency

can be obtained by standardization of the process. The production is thus superior to some of the yeast preparations in its vitamin content. Consumption of 10–20 gr. of the enriched groundnut kernel per day would meet the daily requirement of the vitamin.

It is important to have available at this time, ample and low cost sources of protein and vitamin B_1, and enriched groundnut is the most logical food to fill this need. Such articles of food will receive widespread and permanent acceptance. The enriched groundnut will be acceptable to the people, specially to school children. Increased use of this product will greatly improve the diet and will result in better growth and general improvement in the health and well-being of a large section of the population, particularly the poorer classes of India. It would seem that this is the most economic and feasible method of eradicating beri-beri and combating vitamin B_1 deficiency in India. Other forms of nutritional improvements such as the introduction of 'converted rice', artificially enriched rice, vitamin tablets and other measures suggested from time to time in India may not be so good as this. The advantages to be gained in national health would make it worth while to popularise such products and educate the public in regard to its high nutritive quality. It is hoped that this method of combating vitamin B_1 deficiency in India will merit the attention of Government and Public Health authorities in India.

UTILIZATION OF SOME MINOR FRUITS IN INDIA

by

G. S. Siddappa

(*Central Food Technological Research Institute, Mysore*)

Although considerable progress has been made in the utilization of some of the major fruits of India like mangoes, oranges, etc., by the application of modern scientific methods of preservation, very little work has been done regarding the preservation of a large class of minor fruits, the so-called 'poor man's fruits'. These fruits, among which one may include, jack, custard apple, cashew apple, wood apple, melons, papaya, etc., are often available in plenty, and during season, a large quantity of these fruits go to waste. This wastage should be stopped and the best use made of the fruits by scientific methods of preservation. A beginning has already been made in this direction by some of the State Governments as well as the Union Government. The problem is engaging the earnest attention of a group of workers in the Central Food Technological Research Institute, Mysore. The results obtained already with such fruits as jack, papaya, cashew, wood apple, custard apple, etc., are very promising. There is, therefore, much scope for developing preservation industries for the utilization of minor fruits.

Fruits are important protective foods containing valuable minerals and vitamins. Their importance in diet has been recognized from ancient times. It is only recently, however, that a systematic study has been made in the light of the newer knowledge of nutrition, with the results that fruits have been found to be essential for a balanced diet. They are, however, highly seasonal and are not, therefore, easily available in plenty throughout the year especially during off-seasons. Modern methods of storage and transport have to some extent helped in making them available for some months beyond their season, but the high cost

places them beyond the reach of the average man who needs them most. There are various well-known methods of preserving fruits; some of them are highly technical while others are quite simple and easy to adopt by the average person. Canning and bottling, preparation of juices, squashes and cordials, conversion into jams, jellies, marmalades and preserves, sun-drying and dehydration, cold storage, gas storage, etc., are some of these which are in use in different parts of the world in small homes, (with the help of simple equipment), as well as in huge factories, (with the help of intricate machinery). Fruit preservation is thus one of those useful industries which is highly suited for being worked on a home, cottage and factory scale. During the fruit season, many a home in many parts of the world will be busy with the preparation of such useful things as canned and bottled fruits, jams, jellies and marmalades, juices and squashes, etc., so that they may enrich and brighten an otherwise drab dinner during the lean months of the year. These little activities of a large number of persons go a long way in saving for the nation large quantities of valuable foodstuffs which might otherwise have gone to waste. The larger factories also play their own role in this campaign. In India, however, both types of activities, which are essential from a national point of view in peace as well as in war, are still in their infancy. Intensive propaganda and State patronage are needed to foster these and develop the industry rapidly. A beginning has, however, already been made in this direction, by some of the States as well as the Union Governments.

Among the fruit preservation industries of the world, canning of fruits occupies the first place, the others being generally subsidiary to it. For canning, fruit of first quality only is taken. The second grade fruits, culls and trimmings are converted into jams, squashes, etc. Peaches, pears, apricots, pineapples and plums are the most important fruits used for canning. Other fruits like berries are also canned to a limited extent. Unfortunately these fruits are not available to any great extent in India. They are luxury fruits and very few people can afford to go in for them even as fresh fruit. In the country, however, we have large quantities of fruits like mango, guava, orange, papaya, banana, etc.

A fairly good amount of research work has already been done to standardize methods for preserving these fruits. The commercial packs have, however, to stand competition with foreign products which are highly standardized and which have the backing of enormous capital and technical resources. In spite of these handicaps the Indian canned products are making headway gradually. Mango being the most important commercial fruit of India, it is desirable that the canned mango should take its place with the canned peach or pear of commerce. Unfortunately, only a few of the numerous varieties of mangoes are suitable for canning. Of these Benishan, Alphonso, Neelum and Langra are the most important commercial varieties. They have, however, certain minor defects for a good canning fruit. A search has to be made for new varieties with desirable characteristics. This, however, is a long-range problem and takes many years. At present our immediate attention should, therefore, be directed to the utilization of the existing varieties of fruits, keeping the long-range problem in view all the time.

Apart from these well-known commercial fruits, there are a large number of other minor fruits, the so-called 'poor man's fruits', which have not been properly utilized so far. During season many of them are wasted for want of knowledge regarding their utilization for the preparation of useful food products. Further, even for some of the major fruits like bananas, guavas, papayas, etc., simpler methods than the ones in vogue have to be worked out so that they can be easily followed by a large number of people in their own homes. By doing this a large percentage of the wastage of fruit can be avoided. The jack fruit, cashew apple, custard apple, wild fig, wood apple, sapota, *Carissa carandas, Amla*, etc., are some of the minor fruits which at present are not being fully utilized. For lack of adequate scientific data, they are sometimes looked down upon as 'poor man's fruits'. Some of them may prove to be rich sources of valuable minerals and vitamins. In England the black currant which was not thought of, other than as a fruit for jelly making finally proved to be the most valuable indigenous source for preparing syrups rich in vitamin C required to save her children during the War when

supplies of citrus fruits were cut off. Work on the utilization of some of the minor fruits has been taken up in the laboratories of the Central Food Technological Research Institute, Mysore, and the results obtained so far are very interesting. Papaya has been found to be a good source for the preparation of pectin which is generally prepared from citrus fruits or apples, both of which belong to the luxury class of fruits in India. In other countries, however, these fruits are available in large quantities for profitable conversion into by-products like pectin, etc. The cashew apple which goes to waste, is an important minor fruit. It is available in large quantities during the season. A small quantity is consumed in *situ* as fresh fruit. It has poor keeping qualities. Experiments have shown that a soft beverage, cashew cordial, can be prepared from this fruit. The fruit is available in such large quantities that a sizeable industry can be built on it.

Wood apple jelly is an excellent product. Large quantities of wood apple are easily available in the country. Experiments have shown that pectin can be got out of the fruit. The whole pulp can also be used with advantage in the preparation of mixed fruit jams and jellies.

Custard apples are found wild in the South. The pulp can be canned as such or made into jam or cheese. The seeds are rich in oil, which may find use in arts and industries.

The jack fruit is a very useful one and is of considerable interest to the fruit preserver. Recently, a series of investigations have been conducted in these laboratories. The bulbs give an excellent canned product. The pH of the fruit is rather high (5.0) and the processing in cans or bottles has, therefore, to be done carefully. At present large quantities of the fruit are available in different regions of South India. Although the fruits have not been standardized as in the case of mango on account of the inherent defect due to raising the trees from seeds, the existing fruits can be graded and canned. The canned product is far superior even to the fresh product, which cannot be said of many other canned fruits. Using jack fruit, jams, squashes, preserves, etc., can be prepared. The raw jack gives an excellent curried product. When canned with spices as such or with other

vegetables like potatoes, tomatoes, etc., the canned product is of an attractive light buff colour and resembles meat in many ways. It may be called almost 'vegetable meat'. Raw jack is useful for preparing sweet or hot pickles in oil or in vinegar.

Sapotas are grown in different parts of the Madras State. The fruits are soft and pulpy and do not travel well when ripe. During the season large quantities of this fruit go to waste. Preliminary work has shown that the pulp can be packed as such or made into jam with other fruits like pineapple, mango, etc. Sapota squash also is a fairly good beverage. The important problem in the preservation of this fruit will be the removal of the grittiness in the pulp.

Amla, especially the big wild one from the forests, has already proved its worth as a rich source of vitamin C. *Amla* squash without its astringency should be a boon to the country on account of its vitamin C. The fruit can also be pickled or made into preserves. *Amla* products are famous in Ayurvedic medicine.

Wild figs, *Carissa carandas, jaman*, water melon, musk melon, etc., are some of the other minor fruits which are awaiting the scientist's touch to raise them from their present status of poor fruits to become the assets of the nation. The challenge is a big one. Are the scientists and the industrialists prepared to take up this challenge? I believe that they are.

TECHNICAL PERSONNEL IN FOOD INDUSTRY

by

A. Sreenivasan

(Dept. of Chemical Technology, University of Bombay, Bombay)

The value of research in the development of food industries, the need for liaison between industries and research institutions and the importance of employing scientific and technical personnel in food industries are stressed in this paper.

I VENTURE to put before you a few random observations on scientific and technical personnel and on the value of research in general, in the development of our food industries. I am conscious that, before a distinguished audience such as the one assembled here today, there is no need of discussing the importance of research and technology to our over-all economy and standard of living. We all know that they are both basic to progress. Nevertheless, occasions like this help us to take fresh reviews of our position and check up against the achievements that have been made possible in more progressive countries. This is especially so in the food-field; for there is reason, now more than ever before, to be alert to every factor that will make for efficient use of present and potential food resources as we gird ourselves to meet a situation that presents the greatest hazards and challenge to our national economy.

The development of food industries in our country is of comparatively recent origin. The two successive World Wars have helped to give it importance and a status of its own. Despite a conservative outlook in certain quarters, I think we can take it that the industry has come to stay. But, for an infant industry to grow to vigorous adult stature, a great deal of encouragement and support should be forthcoming from the Government. In other countries, governments have contributed much to the development of this industry. State and Federal aids have been liberally doled out by the United States and notably by the Australian

Government. The industry gets containers, credit facilities, subsid to the products, to sugar, and so on. The position unfortunatel has been rather different in India.

Although initially some government aid in various direction was forthcoming, there has been a set-back due to our acut economic distress; but there are indications of a rapid revival o Government support. The inception and functioning of thi august Institution is an excellent testimony to Government' interest in the subject. The fact is however that the industry ha not progressed along any sort of planned path. It has been hit-or-miss or succeed-if-you-dare policy. No blame shoul therefore be attached to industrialists who are more keen o taking to other established industries which yield better returns Few of the existing food industries are probably being run o scientific lines. I read a recent report that, out of the existin 454 licensed fruit processing factories in the country, only in 55 production is in the hands of fully qualified experts and ex perienced hands. Information as to improvements in machinery buildings, and sanitary equipment, etc., was forthcoming fro only 37 of these factories. Figures of production, sales and othe matters could not be had at all. The Fruit Products Contro Order which was administered by the Centre has been relegate to the States and this step, it has been voiced, has not prove satisfactory.

Much of this state of affairs is, I believe, traceable to an utte lack of technical personnel in the industry. For, it is they alon who can develop the industry along right lines. Only they ca supply the energy and the scientific know-how to achieve industria acceleration in the face of material shortage. They could fo instance give the lie to the fundamentally wrong emphasis o cereals and develop alternate sources of subsidiary foods such a is being accomplished in this institute and elsewhere. They ar needed too for securing nutritional adequacy in the face of ration ing in food articles. The example of Great Britain with it balanced distribution of food combined with minimum depen dence on imports, ensuring at the same time the best public healt records, comes to our mind.

Trained men should therefore count ahead of machines. It used to be said (and is still being said of course) that the three factors essential for production are land, capital and labour. Nowadays, however enterprising, companies or individuals do not think of investment unless they can call science to their aid. Every food processing company in the U.S.A. regards research and technical investigations as essential pre-requisites for development in production. It is incorrect to think that no research is needed in the manufacture of products by well-known processing procedures. We often hear of concerns, large and remunerative, that do not even believe in having chemists in their factories, let alone going for research. There is one thing they would do well to remember: that, over a period of time, a successful speciality becomes a neglected commodity unless there is a constant endeavour to keep it continuously improved in quality. Research is necessary on every phase of operations—from the standpoints of processing, quality, uses, packaging and so on. Research is also necessary for progress that is connoted by new product developments. Research alone has led to the remarkable developments in frozen foods, in improvements in heat exchange in canned goods, in the development of antioxidants, emulsifiers, in packaging methods and in diverse other fields.

The American food industry has fully recognized the overwhelming importance of research in food development. Besides having each their own research laboratories, in most cases, they have formed the Nutrition Foundation which is sponsoring very definite problems of a basic nature in various Universities and institutions.

Here, I wish to refer to an aspect of industrial relations sorely neglected in our country. Few of our industries at the present juncture can probably afford to have their own research organizations. Furthermore, industrial problems are often too massive to be studied by individuals and small groups. The industries should therefore harness to their good, institutions like this one and other university centres. Mutual co-operation and friendly collaboration between scientific institutions and industrial establishments are of extreme value both to science and industry.

Industries must foster investigations in those branches of science as would assist them. In western countries, applied research is a charge on the industries which it serves and it is time that our industrialists also recognize the need to support technological and research institutions.

For a proper appreciation of this much-needed liaison between industries and research institutions, for the safeguard and improvement of quality—flavour, colour, nutritive value, etc.—in their products, it becomes obligatory on the part of the industry to have trained food technologists. It has been suggested that the Fruit Products Order should insist on each factory having at least one B.Sc. The food industry is one that needs men trained in many branches of science. It is obviously not possible for our industries to have biochemists, nutritionists, microbiologists, food processors and chemical engineers, all on their staff. The industry has not grown to that dimension as it has in the U.S.A. Hence, the technical personnel for the industry should have had basic training in all these subjects and especially in the fundamentals of food science. They should have shown an ability to concentrate on the factors that really exist in the industry. They should have vision, industriousness and efficiency and should be motivated by the personal satisfaction which comes from their contribution to the progress of man. We all should do well to remember that in the U.S.A. it is the efforts of trained food technologists to put theory into practice that placed the fruits of science and invention within the reach of the average man.

DEVELOPMENT OF NEW FOOD INDUSTRIES

by

Dr V. Subrahmanyan,

(Director, Central Food Technological Research Institute, Mysore)

The author points out that there is considerable scope for the development of the existing food industries as well as new industries in India. He states that a number of starch and protein-rich materials could be used in bakery and biscuit industry. A variety of wild fruits with pleasing aroma and taste could be utilized for the production of new types of beverages, canned and preserved products, etc. India is not lacking in talent and the author points out the need for encouraging the formation of a National Organization for adjudicating all new efforts made in the field of food technology.

New products are being continuously evolved and popularized, in different parts of the world, particularly in Europe and America. Some of them prove to be immediate successes, while others take some years to become popular. This is as true of food products as those used for other purposes. The immediate success of a product depends to some extent on its intrinsic worth, but, to a considerably greater extent, on the amount of advertisement and propaganda behind it.

Several of the food industries of India, either originated or developed to their present positions during the second World War. They were, and are still largely, concerned with the production of known types of products such as breakfast foods, biscuits, fruit and vegetable preserves of different types, etc. In the case of such products, the consumer is already acquainted with them and their uses. The problems of the Industry and the State are largely confined to the reduction of the cost of production and the maintenance of improvement of quality and extension of the market.

We should not, however, rest content with the production of known types of products. We should consider the development

of new types of products, which will have special appeal to consumers and which will command a place in the world market. Apart from the creative effort of the inventor of the process, the method of production should be properly standardized and new methods of testing will have to be evolved. The nutritive value and the uses of the product should be established on sound scientific basis. More than anything else, the possibilities of the product should be made generally known to the consumers in as extensive a manner as possible.

We have a small number of big food manufacturing concerns in our country with sufficient capital and other resources to back their efforts. In such cases, the popularization of a new product may not be very difficult though, even in their case, proper support from an independent authority would be very valuable. On the other hand, there are a large number of small concerns, some of which, at any rate, are capable of putting forth, new creative effort. In addition to these, there are small groups of independent workers and also scientific and other institutions which offer scope for fresh effort. In all such cases, there should be some kind of facility or even stimulus for creative effort. There should be scope for every one, including the lowest placed individual, to come with new ideas and have them developed.

The following are some possible new lines of development. There are a number of starch and protein-rich materials which could find application in the Biscuit and Bakery Industry. We should develop new types of baked products suited to Indian conditions. We have a large number of wild fruits with pleasing aroma and taste, but which have not yet been utilized by the processing industry. Suitable combination of these may produce very attractive preparations with extensive consumer appeal. There is considerable scope for new types of beverages, incorporating fruit juices, as also digestive and carminative principles. Such products can be popularized not only in our country, but also in others. Cheap but wholesome substitutes for cane-sugar are urgently needed. We should create new types of pickles and preserves that will be both pleasing and wholesome. We

can improve on the quality and develop new methods of preserving our sweets. Several new types of ready-to-serve foods require to be developed and made available for the use of the civilian population and the Defence Services. At present, Indian housewives spend a considerable amount of time over their cooking and the menus have remained practically unchanged over several centuries. In addition to these, there is vast scope for concentrated foods, rich in proteins, minerals and vitamins, which would be quite palatable and which would form good supplements to our dietaries. Such foods will find a ready market if their nutritive values can be demonstrated.

If the country is to envisage and develop new types of processed food products, there should be some kind of national organization for adjudicating such effort, rewarding merit and facilitating large-scale development. Such an organization should be a composite body including national leaders, captains of Industry and representatives of the Government and Science. This body should be accessible to every one from the highest to the lowest in the land who can approach them with the confidence that every proposal will receive fair adjudication. The Council of Scientific and Industrial Research has such a Committee for industrial utilization and it is possible that the same body can also act as a national organization. Alternatively, a new body can be set up exclusively for food industries. The scope and functions of this body should be made widely known and contributions for adjudication invited, if necessary, under seal of confidence.

At the present time, there is a great deal of talent in the country, languishing for want of proper encouragement. There are also a large number of potentially talented men and women who are not aware of possibilities in the field and consequently make no effort. If even a few people are encouraged, there will be a considerable measure of stimulus for fresh effort.

Those who have been abroad and have had opportunities to exchange notes with leading thinkers and workers of those countries, will generally agree that the average Indian is not intellectually inferior to those in other countries. In a

country like America, every young aspirant starts with the quiet confidence that he or she has as much chance as anybody else and that if one can achieve something, there is nothing to prevent one from reaching the pinnacle of fame and prosperity. A similar feeling of confidence should be inspired in the minds of our people and particularly the younger generation. Promising contributors should be generously rewarded so that there should be increasing measure of inducement for people to take active interest in the field of applied research. At the present time, there is a feeling that only the capitalist benefits substantially through any invention and that the inventor gets only a meagre return. Such a feeling should go and, in fact, our leaders of Industry should come forward even to make some sacrifices to encourage talent and to share the benefits of inventions, on the most generous scale, with the inventors.

MR P. MARLOW, (Messrs. Baker Perkins [Exports] Ltd.):

FOLLOWING as I do after Mr Raghunatha Rao, and his paper about the manufacture of confectionery machinery in India, I stand before you with a certain trepidation, as I am one of those poor mortals that represent Messrs. Baker Perkins (Exports) Ltd., who are perhaps, one of the largest confectionery machinery manufacturers in the world.

In recent years I have done extensive touring throughout India and I can safely say that to insist on the use of Indian-built equipment by confectionery producers at this stage is doing a dis-service to the Industry. Undoubtedly in the future, confectionery machinery will be made in this country, but it is wrong to force some small engineering works on confectionery manufacturers and expect them to build machinery of which they have had no previous experience.

If the Government insist on the manufacture of confectionery machinery in this country, let it be done at top level and let the scheme be worked out in the same way as that of the Motor Car Industry which was evolved some years ago.

A previous speaker has stated that confectionery in this country is generally bad and is incomparable to imported goods. This is by no means true so far as the larger confectionery manufacturers are concerned.

There are several factories in this country which use the most modern imported equipment and produce confectionery under skilled supervision. If the Indian confectionery industry is given sufficient encouragement by the Government, it will help this industry to take its place in the export market, particularly that of the Far East.

Much has been said about the difficulties facing the Chocolate Industry. It is my feeling that there should be no further expenditure or investment of capital, for this particular industry, until the problem of the transportation of finished goods is solved. We, together with a few other firms in England, are carrying out researches on this problem on behalf of two firms in this country. It is hoped that a satisfactory answer can be found through the medium of dry ice.

There are only 13 refrigerated wagons on the railways of India, and some of these wagons are beyond repair; the majority of these in a reasonable condition are already bespoken to the Magnolia Ice Cream Co.

On the question of biscuits, we have already heard an excellent address on the problems facing this country. There has of course been in the past a very grave shortage of flour, which has resulted in loss of production in factories and increased the price of biscuits. However, the Government are to be commended for having recently given an import Licence to the Federation permitting the importation of 15,000 tons of flour this year. Details of this shipment are being hammered out now between representatives of the Federation and the Government Departments concerned. This importation of flour, will mean continued production in factories and may well result in the cheapening of biscuits.

A belief is held that biscuit equipment can be manufactured in this country. I would stress that a modern biscuit oven is not merely a long metal-box with a heating arrangement at one end, which is the system on which the majority of the country-built ovens operate. We together with our competitors have been building biscuit plant for over 100 years and I think that it is a great pity that biscuit manufacturers in this country should be denied the value of the experience we have gained in this matter.

Regarding bakery, this industry generally is on a very poor standard and I have yet to see a loaf of bread in this country that is comparable with anything produced abroad. This is due to the lack of modern machinery and old-fashioned prejudices held by bakery *mistris*.

However, here again, we can report good progress and we soon hope to order and get at least one, or possibly two, Automatic Bakeries for India.

I know that it is dangerous to pass comments regarding Chemists, but I would in all sincerity state that they can be a very serious danger to the industry. So far as I know, a young man leaves college with a B.Sc., and he is considered fit to hold

the post of a Production Manager. This is not only a mistaken belief but also a dangerous one.

Chemists are, of course, essential to the food industry, but I would urge you to keep them in their appropriate places, *i.e.*, the Research Institutes and Laboratories. By all means call in the help of your chemist from your laboratory if you have any trouble so far as the chemistry of production is concerned; but I would reiterate that a young man of 23, merely because he holds a B.Sc. degree, is in no way qualified to be a Production Manager of a modern food factory.

I am very grateful indeed to Dr Subrahmanyan for inviting me here and if there is anything that can be done either by me or my firm, then please rest assured that assistance will be given gladly at any time.

MR Y. K. RAGHUNATHA RAO, **(Central Food Technological Research Institute, Mysore):**

I HAVE to correct the impression left by Mr Marlow's remarks. Of course I agree that India is not able at present to manufacture the latest type confectionery or biscuit machinery. It is evident that Indian policy will have to be to import, in the present circumstances, the latest and most improved types of machinery for all food industries. But, in the larger interest of the country, it is essential to start some time the making of machinery for our own needs inside India and not to depend entirely on imports. We can modify the designs of imported modern machinery in the light of our needs, our economic conditions and technical facilities available in our workshops. Some very costly big-sized machinery, which may be considered economic in the mechanized countries, may not be necessary on such a scale in India. It may be economic for us to make and work smaller-sized machinery suitable to our needs, machinery which is at the same time efficient and cheap enough to suit the financial capacities of our small-scale manufacturers. India is a large country and we should encourage the growth of small-sized factories using Indian-made machinery. The size of the plant is not the determining factor in the production of quality goods. With trained

intelligent operation, equally high quality goods can be turned out by the smaller manufacturers. Therefore encouragement should be given for individual initiative and training, in advancing our food industries. The policy of the Government should be to encourage manufacture of food machinery, irrespective of whether it is a small or big-scale manufacture. This is the beginning of a technical age in India and we have to keep this in view for national advancement and self-sufficiency. We, of course, welcome and invite the help of our technically advanced friends in the manufacturing industries from foreign countries to help us in our task of building modern food machinery.

CONCLUDING REMARKS BY THE HON'BLE SHRI T. MARIAPPA

Ladies and Gentlemen,

I have listened with great interest and profit to papers read and the very illuminating speeches made by the members who have participated in today's discussions. It is not necessary for me to comment upon what has been said, but I must repudiate one of the suggestions that was made today that we (Government) are not responsive nor interested in the development of the food industry.

I pointed out that no place has been given to the Food Industry in the Programme of the Planning Commission. As Mr Lobo Prabhu stated, there must be an incentive given to the cultivator to grow more food. The programme that is planned in Mysore is to give the cultivator a guaranteed off-take for his product and to give him a choice to sell the surplus food to the consumer locally at the cost price without a middle-man, relaxing rationing, to that extent. As a result of relaxation of rationing last year to a small extent, a serious situation in some parts of the State was averted—such concessions would help to a great extent in relieving the food shortage. This policy should be examined and pursued. Proper preservation of produced food

materials—both in rural and urban areas, is also very important. Even the food products, imported at a very high cost, have been lost for lack of proper and efficient methods of preservation before distribution to the public. Even the cultivator cannot preserve the entire quantity he produces.

For implementing the proposal of the establishment of processed and other food industries, there must be raw materials in sufficient quantity. You experts must put your heads together and devise ways and means to develop food industries.

Referring to Dr Siddappa's suggestions, I think that varieties of minor fruits available in our forests could be obtained plentifully and used for preservation.

We must convince our women at home about the utility of these products and the advisability of avoiding the wastage in the present context of shortage of food in the country.

Your discussions and suggestions should not be wasted. A Committee of Experts consisting of 5 persons should be appointed to evolve practical proposals for implementation within the next 5 years, which may be helpful both to the State and the Central Government. These proposals may be sent to the Planning Commission for consideration at this opportune moment stating that raw materials are available in the country, that waste products could be made use of and that the necessary skill and personnel could be provided by this Institute.

With these few words, gentlemen, I thank you for the constructive suggestions you have put forward in a practical way. You are interested in solving these problems and if you elect a body of 5 people and sit for an hour or two and draw up a skeleton scheme, indicating the way in which each State or Government can implement it, this will take us a long way.

* * * *

The proceedings came to a close with a vote of thanks proposed by Dr Girdhari Lal.

APPENDIX

Recommendations made by the Committee appointed at the suggestion of the Hon'ble Sri T. Mariappa, Minister for Home, Food, Agriculture and Public Works, Mysore, on the occasion of the Symposia on "Food and Population" and "Development of Food Industries in India" held at the Central Food Technological Research Institute, Mysore on the 23rd and 24th May, 1951.

List of members of the Committee:

1. Mr Luis Jose de Souza, Messrs. Food Preservers, Bombay.
2. Shri Premnarain, Ganesh Flour Mills, Delhi.
3. Shri N. R. Sathe, Messrs. The Sathe Biscuit & Chocolate Co., Ltd., Poona.
4. Mr N. A. Parkes, East India Distilleries & Sugar Factories Ltd., Nellikuppam.
5. Shri P. R. Balakrishnan, Metallurgical Chemical Industries, Bhadravati.
6. Dr V. Subrahmanyan, Director, The Central Food Technological Research Institute, Mysore (Convener).

Recommendations Made with Reference to the Symposium on "Food and Population".

1. The Committee note that while the population in India has increased tremendously during the last 30 years, the food production has lagged behind, and recommend that the State should take immediate measures to restrict the growth of population by suitable birth control and family planning methods.

2. The Committee note that the "Grow More Food" campaign has not yet yielded the desired results and that it is necessary to maintain complete statistics of the progress of the scheme.

3. The Committee agree with the suggestion put forth that it would be in the interest of national economy to give a better deal to the farmer for his produce than to purchase food from

abroad at considerable expense to the Exchequer. This would also give an incentive to the farmer to produce more.

4. The Committee consider that the above recommendations, if implemented simultaneously, will ease the food situation in due course; and recommend as an immediate measure, the production and popularization of subsidiary foods from tubers, like synthetic grains from tapioca and defatted groundnut cake, a product already standardized at the Central Food Technological Research Institute, Mysore. The Committee further recommend that for developing this industry, immediate steps should be taken for the production of tapioca in sufficient quantities and defatted groundnut cake.

Recommendations Made with Reference to the Symposium on the "Development of Food Industries in India".

The Committee are of opinion that the existing, different types of food industries in India with an aggregate registered capital of about 150 crores of rupees and an annual turnover valued at over Rs 1,500 crores were working mostly on the momentum gained during the war-time and that further technical assistance, protection and discipline would be necessary for them. In particular, the Committee recommend:

√1. That it is necessary to lay down standards and specifications, analyse supplies and certify the products, produced under approved conditions. This could be done through 2 agencies, namely Government agency and the Indian Standards Institution on the one hand, and Associations of individual food industries on the other, which should endeavour to enforce standards and maintain appropriate discipline. There should be a definite State Policy to restrict Government help mainly to such industries as would accept the necessary discipline.

2. That group research should be established to evolve the food acceptance of different classes of processed products by having panels of judges consisting of producers and consumers in different localities. The Committee also consider it necessary

to educate the public into a proper appreciation of indigenous processed food products.

3. That Government should continue to give incentives to growers to encourage the production of raw materials of the right quality for food industries. The regularity of supplies of raw materials to the industry should be ensured so that the cost of production may be brought down.

4. That in view of the various raw materials in short supply the growth of small factories, in which hygienic and scientific standards and rigorous chemical and micro-biological controls cannot be operated, should not be encouraged at this stage.

5. That (*i*) a regular supply of imported tin-plate of the requisite standard should be ensured and made available to food industries and the indigenous tin-plate used for other purposes,

that (*ii*) the production and standardization of adequate packing materials of non-absorbent and anti-oxidant type to increase the storage life of processed foods are a pressing necessity. Such packing materials are of vital importance to industries like Biscuits and Confectionery and as such they should be made available to the industries, and

that (*iii*) the Central Food Technological Research Institute, Mysore should carry out systematic investigations on Indian tin-plate and the packing materials referred to above, to study their suitability for use in Indian food industries.

6. That a beginning should be made in the direction of offering air-conditioning facilities for certain food products so that manufactured and packed materials may not deteriorate in transit.

7. That the Government might consider the total or partial remission of the excise duty on sugar for confectionery and fruit preservation industry with a view to promoting the growth of these industries.

8. That the Government might consider offering facilities to food industries in the form of import licenses for procuring raw materials, reduction on freight, etc., to such industries as are ready to standardize their products. It will be in the interest

of the chocolate industry if import permit is granted for procuring cocoa seeds till such time as cocoa beans will be produced in the country. In this connection, it is recommended that the possibility of growing cocoa plantations in suitable areas may be investigated.

9. That the fisheries of the country await scientific development and proper incentive should be given to the growth of model fish-curing yards and to the processing, canning and transport of fish products.

10. That the Government might consider the grant of export licences to industries for exporting the Indian processed foodstuffs to near foreign markets. This would maintain good business relations with neighbouring countries and help to bring in foreign currency.

11. That Government institutions may help the food industries by carrying out, whenever necessary, pilot plant experiments for the utilization of by-products so that plants of bigger capacities may be imported after successful completion of pilot plant experiments.

12. That the Central Food Technological Research Institute, Mysore should give every technical assistance to, and establish close contacts with, food industries, big and small, so that the Government may be guided by recommendations of this Institute on all technical matters regarding the development of food industries.

INDEX

D

J

Y

PRINTED IN INDIA BY HUGH WARREN
AT THE WESLEY PRESS, MYSORE


There are No biscuits Like BRITANNIA Biscuits!
First for Flavour
First for Quality
First for Variety
First for Freshness
more people buy
better biscuits
BRITANNIA
FBMI

MEALS TIME OR
ANY TIME - Delicious
With
BT
VANASPATHI
and
TEMPLE BRAND
REFINED
VEGETABLE OIL
Manufactured by
BRAHMAPPA
TAVANAPPANAVAR LTD.


PRIDE OF INDIA
J.B. MANGHARAM'S
CREAM WAFER Biscuits
Most
DELICIOUS
CRISP
CRUNCHY
&
TASTY
FIRST TIME
MADE IN
INDIA
JB
Cream
WAFERS
J B MANGHARAM & Co. GWALIOR
JB
J.B. MANGHARAM & Co.
Manufacturers of
QUALITY BISCUITS & CONFECTIONERY
GWALIOR (INDIA)

P. No.	Due date	Return date
	24/10/62	22/8/62
160.	11/2	29/1
290	15/4/63	5/4
~~221~~	~~23/7/63~~	
D/P 1	31/8/63	19/8
D. 21.	8/9	29/8
46	27/12/63	30/12/63
	27/5	30/5/64
—	19-9-64	18/9/64